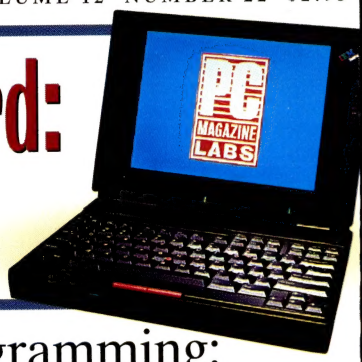
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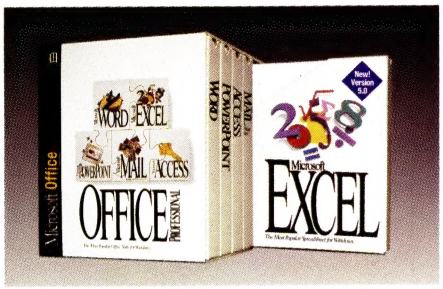
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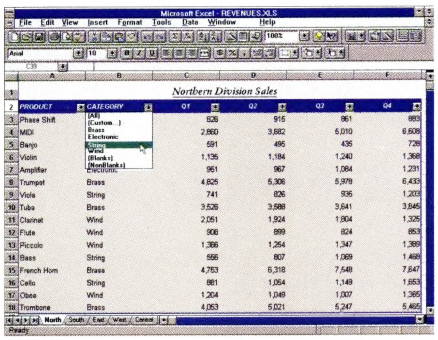
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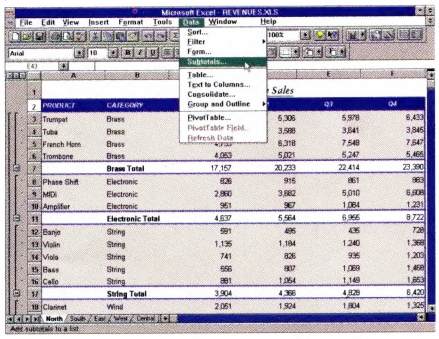
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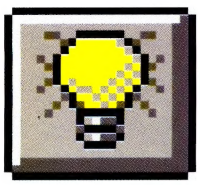


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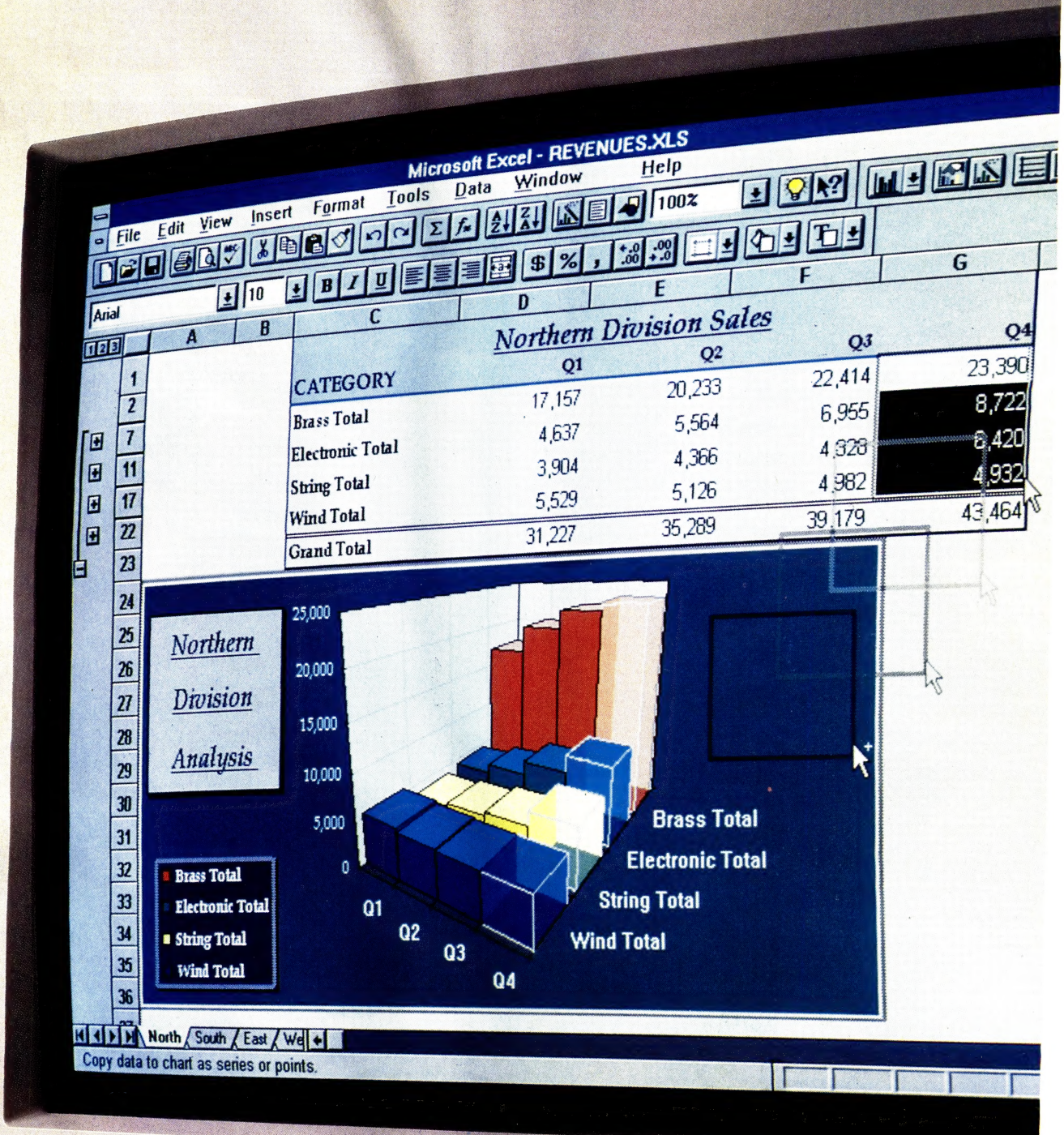
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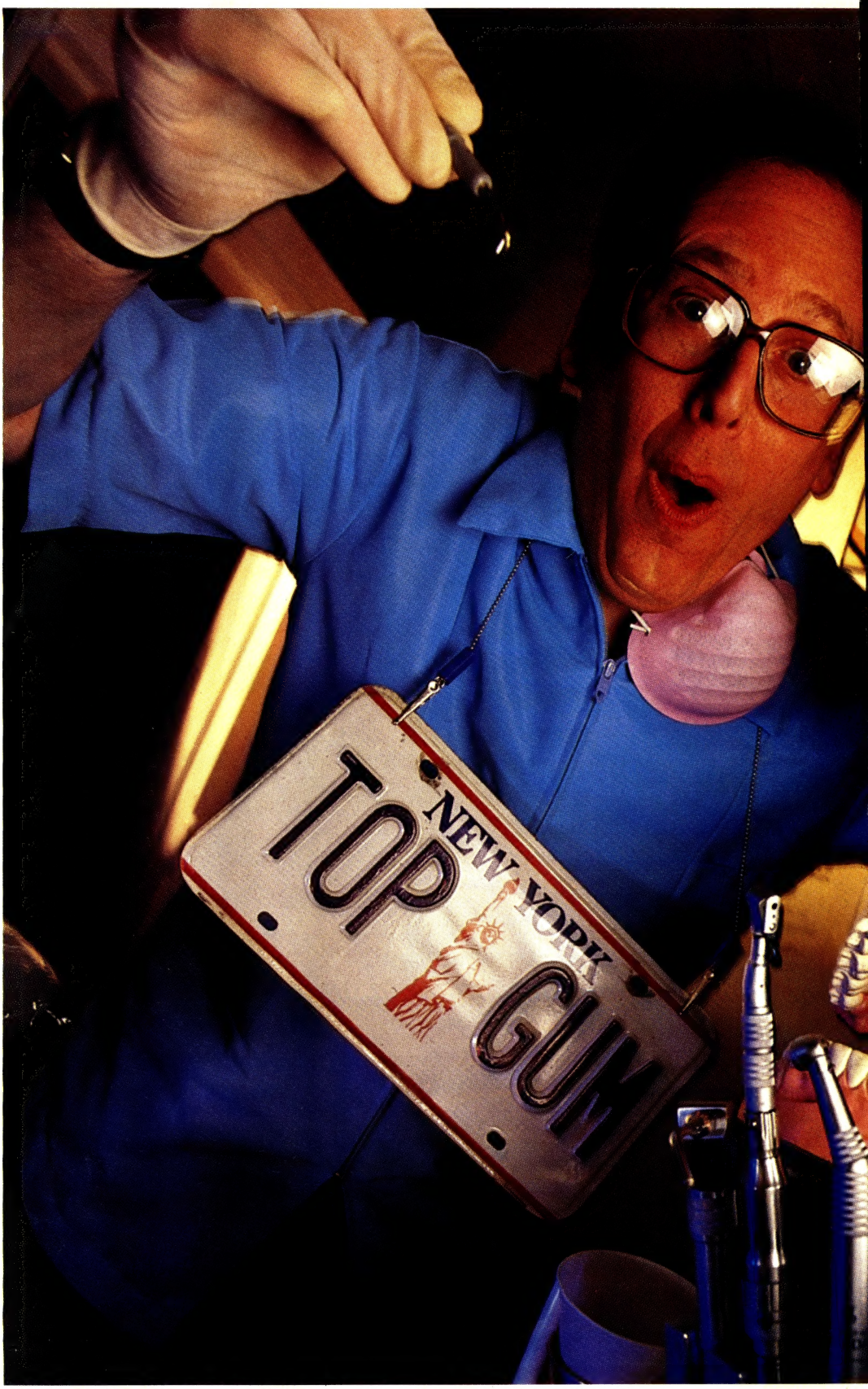
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Electronic Total 4,637 5,564 6,955 8,722
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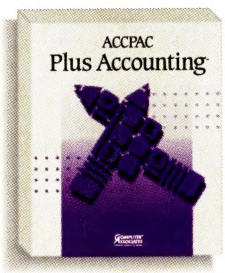
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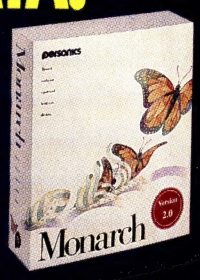
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Inside

Our Annual Awards for Technical Excellence reflect the state of the art of the industry, not who has sold the most boxes or done the best marketing job. For this reason, these awards have acquired and retain considerable prestige despite the proliferation of imitation and wannabe awards. One reason is that, unlike some of our competitors, we only recognize products that have shipped by the time we choose the winners. This year the cutoff date was September 30, 1993.

We take our awards quite seriously. The products listed in this issue have survived a rigorous process of debate, balloting, further debate, and more balloting among our editors and contributing editors. Vendors have zero clout, although they keep looking for innovative ways to lobby the people who determine the winners and losers.

There is not a lot of politeness in this process. Anyone who nominates a product had better be prepared for a lot of "flame mail" from detractors. At times, the discussion takes on the appearance of electronic mud wrestling. But there is a purpose: By the time a product has gone through the selection process, even those who hated it have come to understand why it was nominated and why it survives as a finalist or as a winner.



The goal is simple: to reward the innovators who continue to make the personal computer industry one of the most exciting in human history. Our problem is never a paucity of nominations; rather, the difficulty is to pare down the list to the fortunate few who have survived the verbal and critical gauntlet.

The winners are not necessarily commercial successes. The public does not always rush to reward genius. We believe that this year's nominees reflect the constant evolution of an industry that has served us well and that continues to enlighten and amaze.

—Joel Dreyfuss

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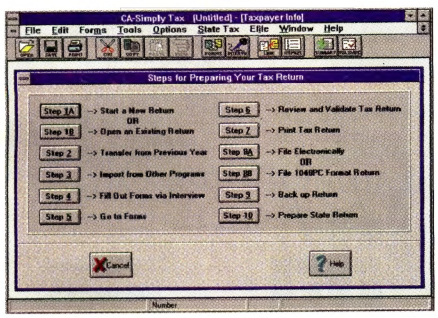
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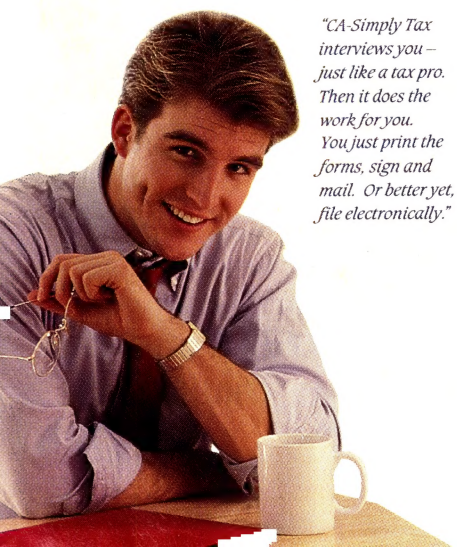
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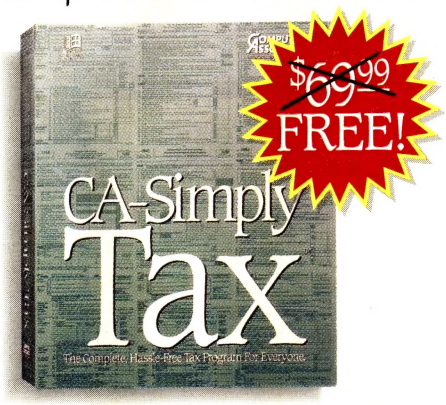
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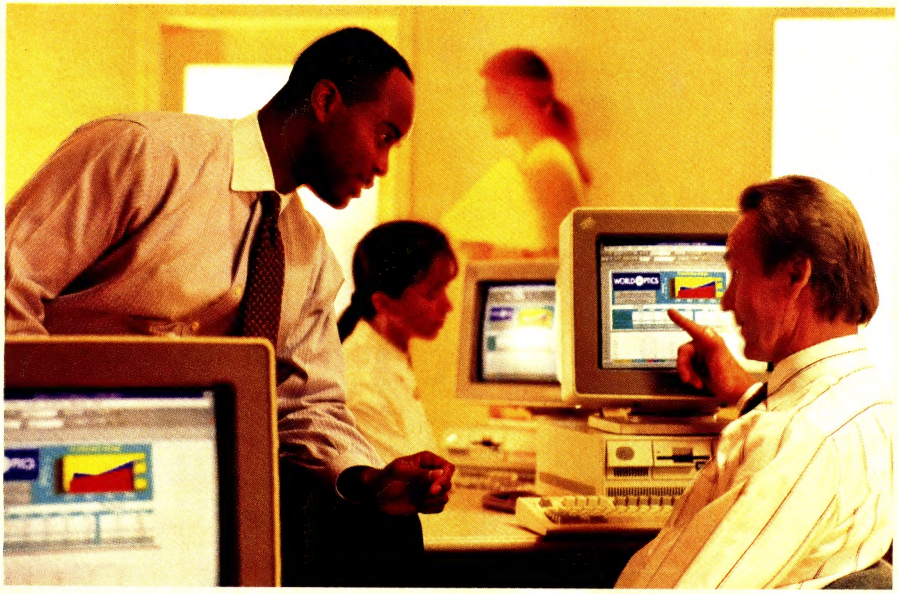
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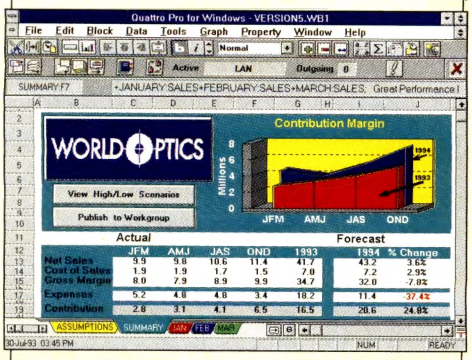
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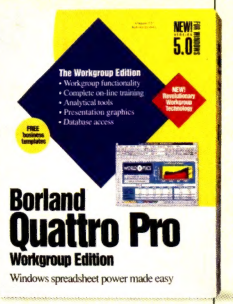


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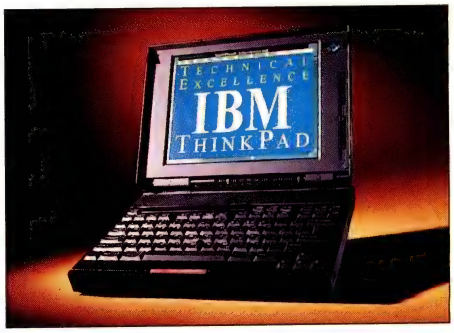
COVER STORY

Technical Excellence

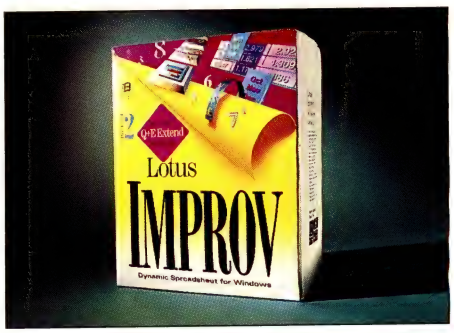
The 10th Annual Awards for Technical Excellence

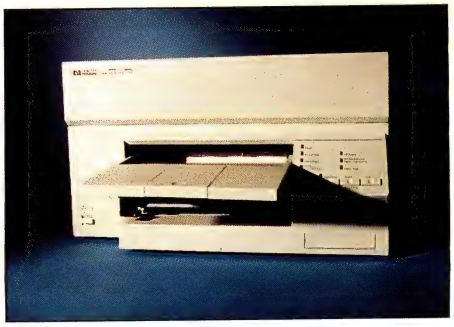
BY MICHAEL J. MILLER

After years of heady growth and bold innovation, the rate of change in the PC industry shows no signs of slowing. Continuing a decade of tradition, *PC Magazine* honors the outstanding products, designs, and technologies of 1993 that set the pace. Chosen after weeks of discussion and debate among *PC Magazine*'s editors, Labs staff, and contributors, our picks define the current state of the art in personal computing and point out directions for the future. **111**









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Color Goes Mainstream



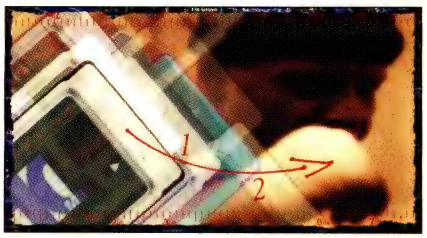
BY JOEL DREYFUSS Cheaper and better screens are bringing color within reach of a majority of notebook users; at the same time, improvements in battery technology are making the switch nearly painless. *PC Magazine* looks at 33 of today's newest notebooks to see which ones best open the world of color **191**

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BY OLIVER RIST PCMCIA technology, which reduces familiar PC peripherals like hard disks, modems, and network adapters to the size of credit cards, has become easier to use. But compatibility is still a key concern. Are PCMCIA cards ready for prime time? Or should you wait a little longer for the technology to mature? *PC Magazine* uncovers the reality behind the hype and the potential **263**

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MagicRAM Token-Ring Credit Card Adapter
Pure Data PDMCIA9025-4/16



Thomas-Conrad TC-Card Token Ring 16/4Mbps PCMCIA Adapter

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TAKE THE PLUNGE: SportsWork's wide variety of categories makes a splash (page 444).

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If you are dissatisfied with a product advertised in *PC Magazine* and cannot resolve the problem with the vendor, write (do not call) Jennifer Roth, Advertising Department, at the above address. Include copies of your correspondence with the vendor.

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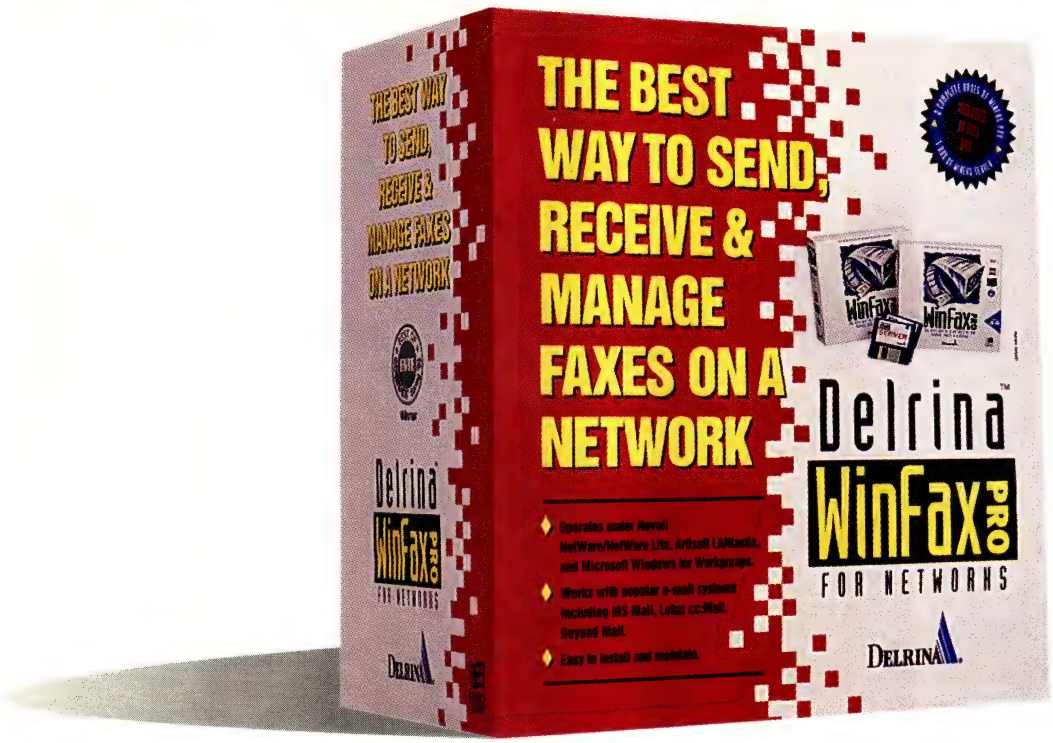
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Except where noted: All *PC Magazine* reviews are of currently available products. Benchmark and performance tests are run on Compaq Deskpro 386/25s and 25e's.

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LOTUS CC:MAIL	YES	NO	NO	NO

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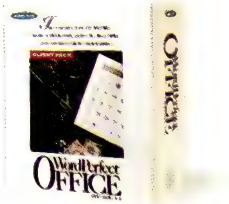


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SC-528UXL	15"	0.28		□	□	□	□	□	
SC-528MXL	15"	0.28		□	□	□	□	□	□
SC-726UXL	17"	0.26		□	□	□	□	□	□
SC-726MXL	17"	0.26	□	□	□	□	□	□	□

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Letters

PDAS ARE HERE TO STAY

Once again, *PC Magazine* has outdone the competition! Your October 12, 1993, "Pen Pals" article was the most informative review of the various PDA and PDA-size offerings I've seen so far. I had already read a short review of the Tandy, Casio, and Apple units elsewhere, but yours was by far superior. You get first place honors for this review.

In spite of the naysayers' rhetoric, PDA technology will find bona fide applications in the real world.

Mike Ossing
Columbus, Ohio

SEEDY ROMS

Robin Raskin's Pipeline column "Seedy ROM" (October 12, 1993) noted the recent burst of media hype surrounding adult software. Most people with access to a BBS will have probably found a few adult .BMP files, despite recent crack downs. But I doubt that anyone has accidentally downloaded NAKED16.BMP.

The same is true of the adult software advertised for sale in your magazine. I hope *PC Magazine* will not interfere with the truthful and informative advertising of these products. Adult software is one of the safest and most easily accessible types of erotic entertainment around, and I hope *PC Magazine* will do its part to keep it that way.

Aimee A. Hall
Amherst, Massachusetts

I must admit that I was anxious to read what your magazine would write about the adult software industry. Needless to say, I was disappointed to read that Ms. Raskin had "no answers and many mixed emotions about where we are heading." I agree with her that computers are now a medium and are therefore incapable of escaping pornographic material. But this does not mean that your magazine should contribute to it through advertisements for adult software.

PC Magazine has the unique opportunity to shine and stand strong in the industry community as a leader with single-minded commitment to decency and the courage to fight against the degradation of women.

Mike Harris
Longwood, Florida



PDA technology will find bona fide applications in the real world.

I read with appreciation Robin Raskin's Pipeline column about "Seedy ROM." She echoed many of the thoughts I have had on the subject for some time, and I was wondering when, if ever, *PC Magazine* would address the issue. I would like to thank her for stating up front what this phenomenon is—pornography, not "adult entertainment" or some similar euphemism.

This is the material that leads to the devaluation of women to the status of impersonal sexual playthings, reduces men's inhibitions toward asocial behavior, and further weakens families already stressed by many other factors in our society.

Richard D. Lanser, Jr.
Elverson, Pennsylvania

• In the interest of maintaining an appropriate "look and feel" to our advertising sections, *PC Magazine* has instituted a number of policy changes. Effective January, 1994, there will be no advertising of adult computer products in our Premier advertising section. Adult advertisements may appear in the Classified section as text only; no graphic illustrations will be permitted.

***PC Magazine* reserves the right to monitor the language of advertisements for offensive terms.**

We feel these changes will preserve the varying interests of all of our readers. Ziff-Davis remains committed to commercial free speech, and *PC Magazine*'s advertising columns continue to be open to all PC products.—Ed.

NT'S KILLER APPETITE?

I got a good laugh from John C. Dvorak's column, "Windows NT: Workstation Killer," in the October 12, 1993, issue. Mr. Dvorak argues that Windows NT will kill the workstation market because "the performance of the cheap desktop PC is not that far behind that of the expensive workstation." Clearly, Mr. Dvorak has never done any serious computing on a workstation. In my work on a Compaq Deskpro 66M and a Sun Sparc10 Model 30, I find a desktop PC takes roughly 10 times as long as the Sun to run the identical job using the same software.

Mr. Dvorak is right in saying that Unix is not a particularly friendly interface and that workstation users will benefit from a more Windows-like environment. But to claim that PCs with Windows NT will kill the workstation market is an absurdity. The market for workstations will eventually replace large, computation-intensive mainframe applications, a market in which PCs with Intel-type chips cannot compete because they are still simply too slow.

Brian Reeder
Salem, Oregon

GUIDED THROUGH THE MAZE

Thanks for the excellent review of a range of affordable computers and value-line systems in the September 28, 1993 issue ("Value-Line PCs: Family Values"). It was a very helpful and informative summation. I bought my last computer in 1986. Much has changed since then, and your articles helped me understand those changes. Keep up the good work.

Lynn Mickleson
Kodiale, Arkansas



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CIRCLE 363 ON READER SERVICE CARD

LETTERS

UPS AND DOWNS

I read "Keeping Up with UPSs" (September 14, 1993) with anticipation, hoping to find a good unit for a user like myself operating a single, nonnetworked 386 or 486 computer. All of the recommended UPSs would more than satisfy my needs. However, I found the price range daunting. What about recommendations for those of us who are not operating a network file server but need good surge protection and no more than 5 to 10 minutes to save current work? I would think we constitute an appreciable part of the PC market.

Mark Henigan
Modesto, California

• Lower-powered versions of the tested units start at $100. All provide reliable backup, although ZD Labs has observed wide variances in the level of surge protection.—Ed.

With regards to your UPS review: An important trait in UPS evaluation has been glossed over—modularity. As a network administrator, I have discovered that many problems with UPSs are often related to the volatile demands of the environments. The downsizing of systems, as well as the enlargement of networks, often creates the factors of undersizing or oversizing the UPSs for the system, hence the cost-effectiveness and the efficiency of the system are questioned. The solution to these needs is modularity—in terms of capacity, backup time, and equipment (with voltage regulators, surge suppressors, and so on).

Kok Hoong, Sito
Kuala Lumpur, Malaysia

HOW TO WRITE TO PC MAGAZINE

We welcome your comments and suggestions. Please send your correspondence to Letters, *PC Magazine*, One Park Avenue, New York, NY 10016-5802, or upload it to PC MagNet (see page 12 for access information). All letters become the property of *PC Magazine* and are subject to editing.

CORRECTIONS AND AMPLIFICATIONS

In *PC Magazine*'s review of 29 uninterruptible power supplies ("Keeping Up with UPSs," September 14, 1993), Exide Electronics Corp.'s Powerware Personal Series Model 800 VA was mistakenly tested with an extra-cost extended-life battery attached. We based the Exide unit's Editors' Choice rating on its backup operation; it ran for 37 minutes at 75 percent load (and, confusing the issue, we inadvertently referred to the Exide UPS as the Deltec PowerRite in the Editors' Choice box). In retests with the standard battery configuration, ZD Labs measured rundown times of 17 minutes at 75 percent of its rated load and 19 minutes with a fixed load of 360 watts. These new results are better than the median rundown scores for all 29 UPS units—12 minutes (75 percent load) and 11 minutes (fixed load)—but not by a large enough margin to merit an Editors' Choice award, which is rescinded. The Powerware Personal Series Model 800 VA should still be included among the units we recommended. Exide says the unit has since been replaced by the less expensive Powerware Prestige 800, which lists for $889.

Four units that we considered unacceptable should in fact be considered conditionally acceptable: the American Power Conversion Back-UPS 600, ITT/Constant Power Dual Power DP900, Perma Power Electronics Perma Power SPS-800L, and Tripp Lite BC 600LAN. These units passed five of the six surge tests (and at least 10 of the 15 static tests) and were judged better than the remaining 11 unacceptable units, which passed zero, one, or two surge tests. While they are not fully on a par with the two Editors' Choice winners and the 12 other recommended UPS units, many users will find them adequate.

Two items on the Summary of Features table were not clearly explained. *Remote notification* refers to the ability of a UPS to send status information to a remote PC on the network or via modem, or to send a message via pager. *Third-party sensing* refers to the ability of the UPS to pass along information from third-party sensors, such as a burglar alarm, sprinkler alarm, or thermostat.

The Summary of Features table in "Portable Printers: Steppin' Out" (August 1993, page 336) indicates that the HP DeskJet Portable printer can print envelopes. In fact, it cannot print envelopes, according to Hewlett-Packard.

In our July 1993 issue, the story "Service and Reliability: Satisfaction amid Change" has an inaccurate entry in its table "PC Vendors: Technical Support and Service Policies." The $30 charge shown in the "overnight shipping cost" column for Epson is actually an overnight charge that does not apply to orders for parts placed during the product warranty period. It applies only to emergency orders for parts.

We would like to clarify some points on APC's Smart-UPS and Back-UPS.

APC's Smart-UPS family originated the SmartBoost feature, yet was overlooked in your discussion of voltage-regulating UPSs. APC Smart-UPSs allow both remote notification and third-party sensing. We feel that network software is the most important (and most interesting) characteristic of the UPS market.

The tested runtime of our Back-UPS was much lower than expected. Since the unit was connected to a network server during shutdown tests, we believe its inverter shutdown feature (low-battery shutdown) had worked in conjunction with the network operating system to appear to lower the unit's runtime. This valuable feature ensures that the UPS is sufficiently charged to provide protection against multiple, sequential outages. Unfortunately, because of the testing procedure, this benefit appeared to be a drawback in the Back-UPS.

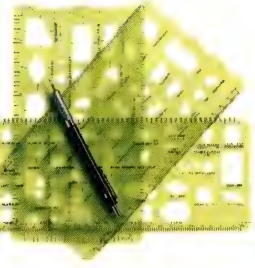
Power protection is a balance of budget versus risk. With that in mind, we believe your judgments on the surge performance of several units may have been too severe.

Aaron L. Davis
Director, Corporate Communications
American Power Conversion Corp.
West Kingston, Rhode Island



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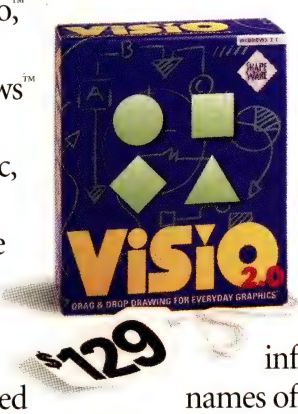
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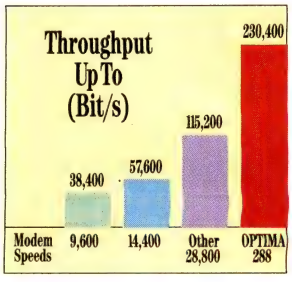


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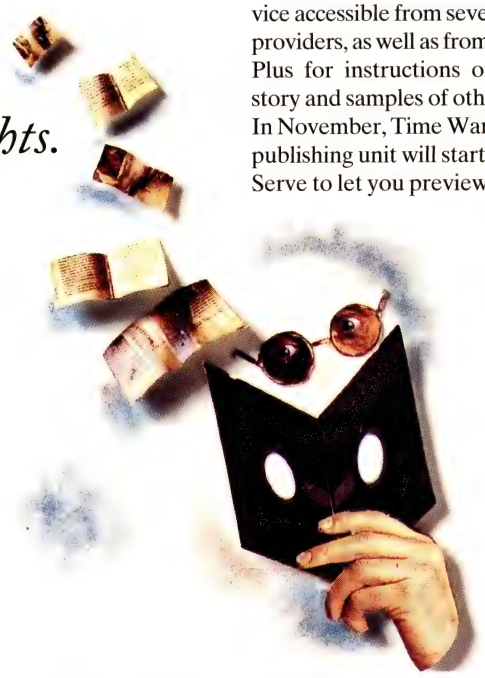
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CIRCLE 350 ON READER SERVICE CARD

The Paperless Book

Publishers scramble for digital rights.



Will digital books replace their venerable printed counterparts? This is the question on many minds as large book publishers jockey for position in an electronic publishing market that has heated up dramatically over the past year.

Paramount Publishing (owner of Simon & Schuster) is one of the industry giants that has recently launched an electronic publishing division. Ted Hill, director of electronic rights at Paramount, sees digital publications broadening the overall market rather than displacing printed book sales. However, he says, "There are some areas—such as reference publishing—in which markets for printed books will disappear or contract."

Catherine Fowler, associate publisher of Random House's reference and electronic publishing division, expects that in three to five years, the company's electronic reference works will be as important a source of revenue as the printed versions. Already, the *Random House Encyclopedia* brings in more money from its licensing for on-disk versions than from its sales in print.

Royalynn O'Connor, product manager of electronic publishing at Oxford University Press, which specializes in reference and scholarly publications, says that when her company acquires books, "We won't sign a contract unless we have electronic rights." She says that Oxford, which now has 70 books on-disk including the *Oxford English Dictionary,* may eventually offer electronic versions of all its titles.

Another hot area is children's books. Random House's Fowler expects that her company's children's books will eventually be as profitable in digital format as in print, now that the company is launching a joint venture with Broderbund Software to publish CD-ROM titles for kids.

On-line services are becoming a valuable resource for publishers, too. Penguin recently published a Stephen King short story in electronic format on the Internet before it appeared in print. "Umney's Last Case," from his latest collection, *Nightmares & Dreamscapes,* is available from the Online Book Store, a service accessible from several Internet gateway providers, as well as from ZiffNet (see Trends Plus for instructions on downloading this story and samples of other electronic books). In November, Time Warner's new electronic publishing unit will start a forum on CompuServe to let you preview new books and talk with authors.

Many libraries are also looking to a future of electronic publications as a way to simplify storage and access. At the forefront is the Columbia University Law Library, which has embarked on a project to replace many of its 750,000 books with scanned digital versions. It expects to digitize 10,000 books a year. And the Library of Congress's American Memory Project is currently digitizing thousands of books from its collections to make them accessible on CD-ROM and on-line.

—Robert Kendall

Illustrations by Ellen Weinstein

Acrobatic Kids

LOOK AT ANY SOCIAL STUDIES OR geography textbook in any classrom in America today, and chances are it's hopelessly out of date. That's because updating texts to keep pace with world events is too expensive. Now, software companies and publishers are hoping that technology can solve the problem.

Adobe's new "Kids Take the Digital Road" software grant program is a $5 million donation of Adobe Acrobat software to public schools (800-521-1976). Its goal is to get more electronic information into classrooms and to establish Acrobat's .PDF (portable document format) as the standard format for electronic documents.

Acrobat is just one of the many programs that publishers are using to digitize books and documents. There's also Farallon's Replica, No Hands Software's Common Ground, Voyager's Expanded Book, and the SGML standard. Acrobat preserves a document's look and feel across platforms (see *PC Magazine,* November 9, 1993).

Electronic document software means texts can be produced, distributed, and updated at a fraction of the cost of paper format. Acrobat will let students create their own electronic "portable" newsletters and reports for on-line distribution.

Kids' publications such as *Sports Illustrated for Kids* and *The Wall Street Journal,* Classroom Edition, are now experimenting with the idea. And the California Technology Project's Guide software, a graphical Internet front end, has incorporated Acrobat to open up a vast array of original materials from the Library of Congress archives.

But roadblocks remain, such as wiring classrooms for phone lines and getting more PCs into schools so kids aren't left in the dust of the electronic superhighway.

—Carol Levin

Pipeline *By Robin Raskin*

Software, L.L. Bean Style

Face it, shopping is passe. Buying a box of software that sits on the display shelf of some miles-of-aisles store is *soooo* traditional. For years we've been dreaming up hi-tech alternatives. (Trivia buffs, remember the Cauzin Softstrip?) The newest twist is the CD-ROM catalog. With at least six major-effort CD-ROM software catalogs ready to roll, we're in for a year that tests the waters and smoothes the ripples out of this new marketing concept.

The premise is simple. You buy a CD-ROM disk full of applications that lie locked and encrypted on the disk. You peruse the disk as you would a catalog, sometimes simply reading specs, sometimes trying the software, and sometimes seeing a canned infomercial. When you want to buy a package, you place an "800 number" phone call and give your user ID and some credit card information. You're given the code to "load" the complete program onto your hard disk and automatically become a registered user.



The first efforts are an interesting bunch. InfoNow is the force behind the CD-ROM samplers from IBM (IBM's 85-app Options CD ships with all Ambra and multimedia ValuePoints) and Gateway 2000's Store-on-a-Disc (Gateway's CD is Microsoft specific—holding 33 Microsoft titles). Both of these let you test full applications for a limited number of sessions. Pricing is competitive with retail. Ingram Micro also has a disk, but for the moment it's for Macs only.

The $9.95 Super Store, from TestDrive, is a CD-ROM that lets you download any of its 40 apps while TestDrive will also mail you shrink-wrapped disks and manuals. Like InfoNow, the applications on the CD-ROM are the full-blown apps.

In its make-good promise to enter the software market, Apple's Software Dispatch uses handsome QuickTime movies to sell you on CD-ROM shopping. The Apple disk mixes disabled versions of the applications with product demos; hard-copy documentation is available on request. Apple's disk includes more than 80 applications from Claris, Computer Associates, Intuit, Lotus, Symantic, and others. Apple says a Windows version should be ready early next year.

Softbank, a venture backed in part by Merisel, offers more than 110 applications on two disks. Softbank is targeting the consumer with a blend of apps from general productivity software from major players to shareware to eclectic utilities from small publishers. Softbank's going to hit hard in the superstores, and its payment scheme includes an "annuity" to both the software developer and the computer store.

The boldest experiment is from KidSoft. The CD-ROM contains kids-only software and comes with a colorful magazine with plenty of interactive games and puzzles.

Issues regarding upgrades, printed documentation, use on multiple machines, and security (see story below) are bound to surface. Once the gotchas are resolved, CD-ROM samplers could be a milestone for shoppers even if they charge a small premium for the convenience.

Robin Raskin is an executive editor at PC Magazine.

Caveat Emptor

SHOPPING BY CD-ROM IS CONVENient for consumers, but it raises questions of practicality. Can I install applications onto my desktop and my notebook? What about hard-copy documentation and upgrades? Since the "try-before-you-buy" idea is so new, the CD-ROM vendors and software developers have yet to work out consistent policies.

The applications on CD-ROM samplers are encrypted in order to control distribution. Apple, Club KidSoft, and Ingram Micro use Rainbow Technologies' encryption algorithm; CD Showcase and Softbank use the government's Data Encryption Standard; and TestDrive uses its own encryption. InfoNow uses RSA's Data Security, a public key-encryption system that requires one password key for encoding and another password key for decoding—should one key be unscrambled, the other half of the key that's required to unlock the app remains scrambled.

Protecting encrypted apps from piracy is not a major issue. "The people to fear are not those who want financial gain, but rather the technical people seeking a challenge," says Softbank's Scott Hillman.

Shopping by CD-ROM is hassle-free. You call an 800 number and trade your credit card number and the alphanumeric code from the CD-ROM catalog for a code key that unlocks the app and transfers it from the CD-ROM to your hard disk.

It's after you purchase an app that the CD-ROM distribution method can get sticky. Multiple installations, even on your laptop or secondary machine, are impossible without repurchasing the software and getting another code key. This is because most samplers' software programs install part of the decryption mechanism onto your hard disk and configure the CD-ROM for that specific hardware. If you try to use the CD on another system, the app appears locked. But you can reinstall the app onto the machine for which the CD-ROM is configured.

Currently, only Softbank and TestDrive will mail you the disks and documentation, while Apple and others offer on-line documentation. Some upgrades are available on CD-ROM; others are available on floppy disk directly from the vendor.

Multiple installations for LANs opens another Pandora's box of unresolved issues. CD-ROM vendors are still working out the details of supporting such orders. —*Melissa J. Perenson*

CD-ROM Comparison Shopping

	Number of applications	Price	Distribution channel	Telephone number
CD Access	165	Free	Stores	N/A ❶
CD Showcase	10 to 50	Varies	Stores	800-926-0364
Club KidSoft	25	$9.95/year subscription	Stores, phone orders; bundled with hardware	800-354-6150
Options by IBM	88	N/A ❷	Bundled with hardware	N/A ❶
Softbank On-Hand	110	$10.00	Stores; bundled with hardware	800-763-8226
Software Dispatch	80 or more	Free	Phone orders; bundled with hardware	800-937-2828 ext. 600
Store-on-a-Disc	34	N/A ❷	Bundled with hardware	N/A ❶
Super Store	82	$9.95	Stores, phone orders; bundled with hardware	800-788-8055

N/A ❶—Not applicable: This product cannot be ordered by telephone.

N/A ❷—Not applicable: This product is bundled with hardware and is not sold separately.

Top Retail Software

Current ranking	Last issue	Product/ company
1	—	**Paradox 4.5 for Windows** *Borland International*
2	10	**QEMM 7.0** *Quarterdeck Office Systems*
3	2	**Quicken 3 for Windows** *Intuit*
4	—	**WordPerfect 6.0 for DOS Upgrade Kit** *WordPerfect Corp.*
5	1	**Quattro Pro 5.0 for Windows** *Borland International*
6	3	**Quicken 7 for DOS** *Intuit*
7	14	**Procomm Plus for Windows 1.02** *Datastorm Technologies*
8	7	**Procomm Plus 2.01** *Datastorm Technologies*
9	4	**MS-DOS 6.0 Upgrade Kit** *Microsoft Corp.*
10	—	**Borland Office 1.0** *Borland International*
11	—	**Microsoft Windows 3.1** *Microsoft Corp.*
12	—	**Microsoft Excel 4.0 for Windows Upgrade Kit** *Microsoft Corp.*
13	12	**Microsoft Access for Windows 1.1 Upgrade Kit** *Microsoft Corp.*
14	9	**Microsoft Office for Windows 3.0** *Microsoft Corp.*
15	10	**Lotus 1-2-3, Release 4 for Windows Upgrade Kit** *Lotus Development Corp.*

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending October 16, 1993. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and can not be interpreted as a picture of the entire software market. Sales information compiled by Ingram Micro.

A Bright Future for Network Apps

NETWORK PROGRAMMING, ONE OF the thorniest areas of application development, just got easier—much easier. With AppWare, a new set of cross-platform and visual programming tools from Novell, developers can quickly build apps that run on Macintosh's System 7, Unix, and Windows, and soon on OS/2 and Windows NT. This isn't just good news for developers. End users will benefit from having more and better network-exploitive and cross-platform software.

Simultaneous with its development of new network services such as telephony and imaging, Novell has purchased two development tool companies: Software Transformation and Serius Corp. Software Transformation has been quietly selling the Universal Component System (UCS), a high-quality set of cross-platform libraries, for about eight years. Novell has renamed the product AppWare Foundation. Currently supporting Windows 3.1, System 7, and three flavors of Unix (UnixWare, SunOS, and HP-UX), AppWare Foundation will add support for OS/2 2.*x*, Windows NT, and AIX by its general release in May 1994. In contrast, Bedrock—the cross-platform tool under development by Symantec and Apple—has been scaled back to support only Windows and System 7.

Serius Corp. developed a visual tool called Serius Developer for building applications without any programming at all (see Trends, November 10, 1992). Serius Developer, now called Visual AppBuilder, uses prewritten components called AppWare Loadable Modules (ALMs) to build applications. ALMs are similar to Visual Basic's custom controls, and can encapsulate virtually any functionality. With versions for Windows 3.1 and the Apple Macintosh, Visual AppBuilder will soon run on even more platforms; it's being rewritten using AppWare Foundation.

AppWare Foundation is unique in its approach to cross-platform development, which is typically plagued by two evil extremes: a least-common-denominator approach that doesn't use the strengths of any particular platform, or a monolithic "virtual operating system" approach that's weighted down by features that many apps can do without. AppWare Foundation walks the middle line by offering a suite of libraries for every area of functionality.

Using AppWare Foundation may not mean having to learn a new API (application programming interface). In a cross-licensing/joint-development agreement, Borland International will incorporate AppWare Foundation into its Object Windows Library (OWL), which is used by over 300,000 developers. OWL for AppWare will be sold by both Borland and Novell.

AppWare is already catching on. Both WordPerfect and Gupta's SQL Windows will use AppWare Foundation for future releases. AppWare Foundation makes it realistic for small, innovative companies to port their products to multiple platforms. The winner is the end user.—*Sheryl Canter*

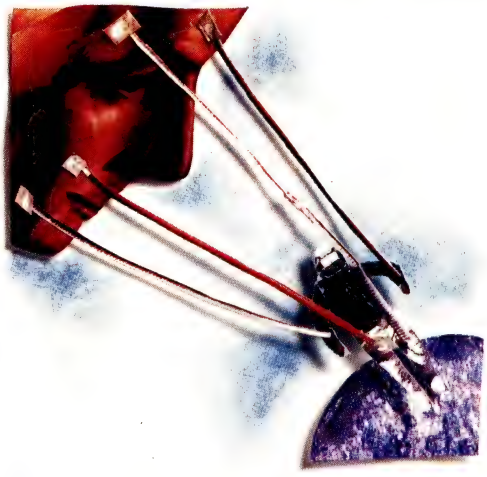
Our Bodies, Our Input Devices

BIOSIGNAL PROCESSING IS ONE OF the latest technologies researchers are exploring as a human-to-machine interface. Not to be confused with biorhythms, which predict whether you'll have a nice day, biosignal processing extracts neural impulses and maps the signals into analog and digital controllers used to work a computer.

BioControl Systems (415-329-8494) is developing two biosignal technologies that track electromyogram (muscle) and electrooculogram (eye) signals by attaching electrodes to your body. The impulses are fed by wire to BioControl's BioMuse, an 8-channel biosignal processor. A wireless radio-controlled BioMuse is under development.

Electrooculogram tracking will make an eye controller possible. Through electrodes that attach to the forehead and cheeks, the movement of the eye is tracked and converted into signals that control a mouse or robot. The eye controller tracks horizontal and vertical (*x*- and *y*-axis) movements, and can detect depth (*z* axis) by following the impulse generated when you focus. You click on an area by moving your jaw.

Electromyogram is used to monitor either a single muscle working alone, or a



group of muscles that are working in unison. The technicians at BioControl hope to replicate complex muscle control in robots, which could then be used to perform tasks too dangerous for humans.

In the meantime, biosystem control technology may let handicapped users operate computers through eye or muscle control. In the future, it may end up in virtual reality games and medical applications.

—*Christopher Barr*

Made in China

THE PRICE OF A COMPUTER SYSTEM is usually based on its manufacturing cost. If a vendor can shave the cost of a component, then it can price the system lower. For example, Apple, Compaq, Dell, and IBM buy motherboards, displays, notebooks, mice, and keyboards in Taiwan, where manufacturing costs are often below those in the U.S. Taiwan's success has meant higher wages for factory workers, so to remain competitive, many manufacturers in Taiwan are now looking to Thailand, Malaysia, and mainland China for cheaper labor.

Setting up shop in China has many advantages for Taiwanese investors. The Taiwanese and Chinese speak the same Mandarin dialect (in Hong Kong, Cantonese is spoken), and China's industrial areas are easy to access by ship or air.

Taiwan's government hasn't officially sanctioned trade with China, but that doesn't seem to stop anyone from exploring manufacturing options or from working through shell corporations in Hong Kong. Taiwan's government is expected to allow investment in China soon.

Although China is a communist country, some feel its heritage is conducive to the same work ethic that brought prosperity to Korea, Hong Kong, and Taiwan. Often referred to as "Confucian Capitalism" because it stresses hard work, moral behavior, and discipline, China has established special economic zones in a number of provinces to encourage commercial development.

Quality control is the biggest concern of Taiwanese manufacturers. The first products to be transferred for Chinese manufacture will be older technologies that require less stringent adherence to high standards. Low-end 386-based systems and 14-inch monitors are prime examples. The first products will be sold in China and Europe, but it won't be long before products made in China will show up on our shores. —*Christopher Barr*

LCDs in the USA

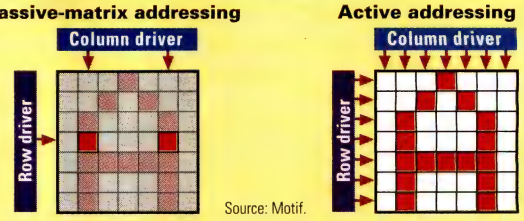
JAPAN CORNERED THE MARKET on one of the hottest technologies for portable computers: color LCD screens. But don't count the U.S. out of the running yet. Silicon Valley was recently selected as the site for a U.S. LCD consortium, and two companies in Oregon have new LCD technologies that will be used in everything from airplanes to video games.

The United States Display Consortium (USDC) is opening a research and development center for LCDs in San Jose. Funded by the federal government's Advanced Research Projects Agency (ARPA), the consortium includes AT&T, Optical Imaging Systems, Planar Systems, Silicon Video, Standish Industries, Tektronix, Xerox, and others. USDC's objective is to provide a direction for LCD panel developers and manufacturers.

Tektronix is developing LCD technology for use in avionics displays and helmet-mounted displays. These high-resolution displays, called NuColor Shutters, use a technology Tektronix dubs *pi-cell*, which utilizes two fast liquid crystals. Pi-cell works with a 180-Hz monochrome cathode-ray-tube (CRT) display that acts as backlight and also sends sequential red, green, and blue signals to Tektronix's LCD. The monochrome CRT is then modulated to create a wide color palette. The result is spectacular color in a display that can be as small as 1 inch or as large as 19 inches.

Motif, another company based in Oregon, is a joint venture between Motorola and In Focus Systems created to develop a new LCD technology called *active addressing*. According to Motif, active addressing will enable LCD panels to perform with the speed and the quality of today's expensive Japanese-made active-matrix color LCDs, but at prices comparable to the less-expensive, lower-quality passive-matrix panels. The first 7-inch color panels are expected off Motif's manufacturing line early in 1994.—*Christopher Barr*

Active Addressing Makes a Sharper Image



Source: Motif.

Traditional passive-matrix addressing produces poor image contrast, as the LCD addresses only one row at a time and neglects other pixels. Active addressing optimizes LCD performance by addressing all pixels simultaneously. But it's still not as sharp as active-matrix (not shown), which has a driver at each pixel.

Briefs

A RASH OF ARMED ROBBERIES AT MICRO- processor distributors in Silicon Valley has prompted Intel to slap a serial number on its chips to help police trace stolen chips and to discourage theft. The laser-etched lot number on the chip's packaging, currently for internal use, will be tracked and used as a serial number. Intel will later add a four-digit code and a bar code.

HOW MUCH EXTRA WILL YOU FORK OVER for a premium brand like IBM? According to a survey by McKinsey & Co. and Intelliquest and reported by *The Wall Street Journal,* IBM fetches a $295 premium. Customers will pay an extra $232 for a Compaq, $92 for Dell, and no premium for Gateway. Respondents expect a discounted price for Zeos, NEC, Everex, and Packard Bell. Other findings: buyers look first to performance and then to brand name when making purchasing decisions.

PROJECT GUTENBERG, AN INTERNET site at the Univeristy of Illinois that's dedicated to digitizing 10,000 historically significant books by the year 2001 is now available on CD_ROM. The $39.95 disk includes historical documents, classic literature, and reference works. Call 800-786-9907.

AMD IS PRINTING A "WINDOWS- compatible" logo on all its 386 and 486 chips. Microsoft's endorsement may help AMD put to rest users' fears of buying a non-Intel chip.

—*Christoper Barr and Carol Levin*

TRENDS PLUS

From December 13 to December 17, you can download several electronic books, as well as a short story by Stephen King, and join an on-line discussion with *PC Magazine* editors and electronic publishers. Type GO EXEC from any CompuServe or ZiffNet prompt.

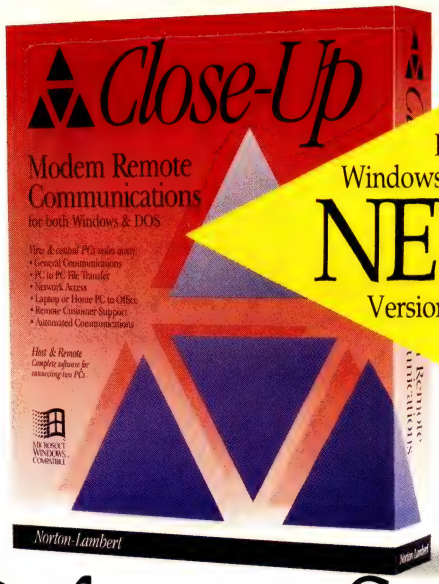


WinBench scores (average of 10 runs):
Close-Up 1,613,118
pcAnywhere 194,093
CarbonCopy 168,397

WinBench™ 3.11 by Ziff-Davis Labs Tests Remote Windows™ Speed

This graph shows the speed of the three leading remote control programs when transferring Windows screens. As you can see, Close-Up handles more pixels, faster, meaning you spend less time waiting for Windows screens.

The industry standard test, WinBench 3.11, is perfect for testing the speed of remotes. It is an accurate measure of video throughput. Video throughput is the limiting factor in remote operations, because remote programs must transmit Windows video functions from one PC to the other.



For Both Windows & DOS
NEW Version **5.0**

New Remote Software Sets Windows Speed Record

Communicate Faster & Easier

Close-Up® lets you communicate faster & easier with five exciting technology firsts.

Close-Up is the only remote communications software that won both PC Magazine's coveted "Editors Choice" and PC World's "Best Buy" awards. Now Close-Up has a new faster & easier version that allows you to view and control another PC by modem as if you were there!

Technology Firsts
1. *AI Video Compression*
2. *Photographic Memory*
3. *Non-Intrusive Technology*
4. *Expert System*
5. *Video Translation*

Why Is Close-Up So Fast?

Close-Up learns as it works. It uses AI (Artificial Intelligence) to compress all Windows video function calls. That's why Close-Up does so well in Windows Benchmark tests (see WinBench 3.11 chart).

Close-Up uses its revolutionary Photographic Memory™ so that once Close-Up has seen all or part of a Windows screen, it's memorized. Then as screens change, Close-Up only transmits new unmemorized data. Incredibly, with this technology ***Close-Up gets faster & faster the longer you use it.***

What Remote Companies Haven't Told You

Other remote programs permanently slow Windows and usually reduce your video resolution and depth of color, even when they are not in memory. That's because they permanently change your system.ini file. Close-Up's breakthrough Non-Intrusive Technology does not modify any of your sensitive Windows files including the system.ini. Close-Up is the only remote that when not in use, allows Windows and your PC to run at normal optimal levels.

Expert System Makes Communications Easy

You don't have to be a communications expert to get the results of one. Close-Up has an Expert System that automatically analyzes system components and configures your system for optimal speed.

Video Translation

With Close-Up, dissimilar PCs can easily connect, because Close-Up senses the video capabilities of both PCs and automatically displays Windows in a video mode compatible with both sides.

RISK FREE GUARANTEE MONEY BACK

Risk-Free Offer!

Try Close-Up. If you're not absolutely convinced that Close-Up 5.0 is the fastest remote program, we'll give you your money back!* Order Close-Up Host & Remote, a complete system, for only **$199.95**

Upgrade your current or competitive remote program to new Close-Up 5.0. Get both sides, Host & Remote, for only **$69.95**

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We invite you to reproduce this test. We used two identical Gateway 4DX2-66V's with 66-MHz Intel 486DX2-66 CPUs, 16 MB RAM, 256KB RAM cache, 340 MB HD, IDE controller, no hardware disk cache. Video: Local Bus ATI Ultra Pro with 2MB VRAM, 640 by 480 pixels, 16 colors, VGA.DRV dated 3/10/92. Monitor 72 Hz. MS-DOS 5.0, SMARTDRV 2 MB cache. Modems: two 14,400 baud V.32bis. WinBench 3.11 is available on ZiffNet accessible via CompuServe. Test performed without verification by Ziff. All products are shipping versions. WinBench trademark of Ziff Communications Co. Windows trademark of Microsoft Corp.

*60 day money-back guarantee if purchased directly from Norton-Lambert. Offer expires 12/31/93. All prices in US Dollars. Prices exclude shipping.

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CIRCLE 346 ON READER SERVICE CARD

Announcing speci designed just for th

If you're one of the following people, your new 1994 DOS or Windows Quicken upgrade is now ready. Both new Quickens are so loaded with new time savings, new financial insight, and new power to organize — you'll think we redesigned it just for the unique way you personally use Quicken. For instance:

A You're too busy to read anything else in this ad.

You busy on-the-go types will love having Quicken organize your finances the way you organize all your other activities — with the new Quicken Financial Calendar.™ It remembers whom you pay, how much, when, how often — and makes the register entries for you automatically.

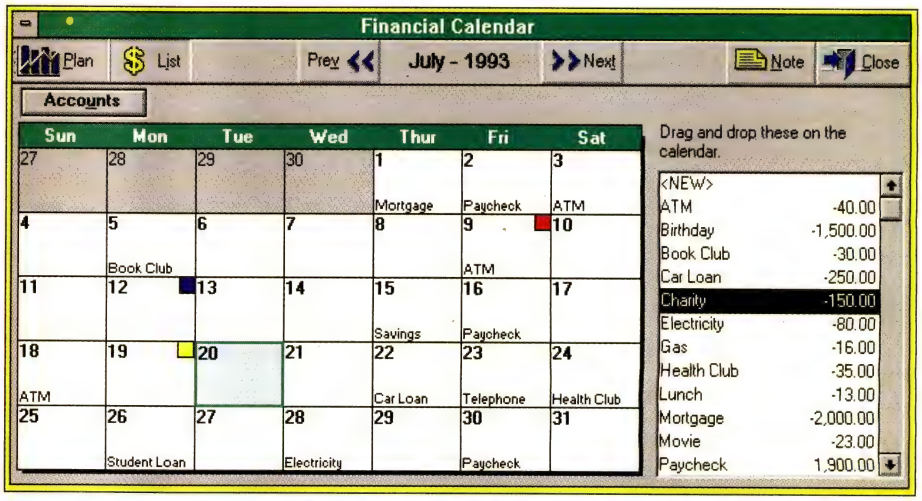
Whether the bill is a 36-payment car loan or a 360-payment mortgage, a twice-a-year property tax bill or your every-month phone bill — schedule it just once on the Financial Calendar, and you never have to enter it again. (You can confirm the amount each time if you wish.) And your regular deposits — weekly paychecks, monthly interest, whatever — are just as easy and convenient to handle automatically.

The Quicken Financial Calendar. It just may be the most radical planning-and-organizing tool since... well, the calendar.

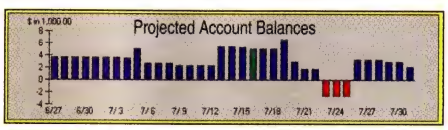
B You just like knowing where your money goes.

New QuickReports are just for you. Zoom out from any individual transaction in a register to see instantly when you last paid that bill or get a list of all transactions for that payee or category. It's like getting an instant "mini-report" any time you need it.

And for the first time ever, new Quicken 3 for Windows even forecasts your future. The new financial planning graph projects your account balances, cash flow and net worth for the next month — or up to the next two years — based on the transactions you've scheduled onto the Financial Calendar.

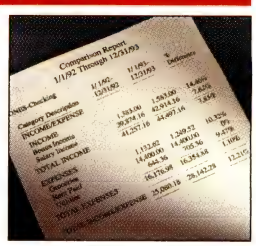


This could be the biggest breakthrough in Quicken ever! Just "drag and drop" transactions to the correct dates. Then let the new Quicken Financial Calendar make all your regular register entries for you automatically from now on. Or, you can put any transaction on "total automatic" and never look at it again — or you can be prompted each time to confirm (or change) the amount. You can also make one-time register entries with the Financial Calendar.



Use this graph to play "What if..." and see the precise impact that decisions like saving more, vacationing sooner or even eating out less will have on your future account balances.

C You don't just organize —you analyze in detail.



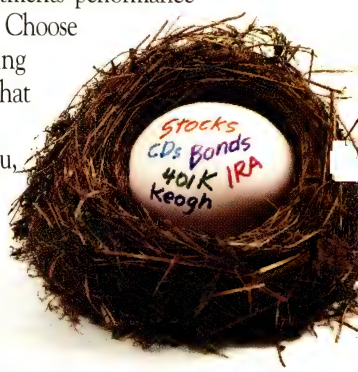
You can compare this year's income and expenses with last year's, or analyze your cash flow with percentage breakdowns. The new comparison report shows any two periods side by side — sorted by account, category, payee or class. And it gives the variance in dollars, as a percentage, or both.

You can also copy reports to the Windows™ clipboard in tab-delimited format, for easy import into your spreadsheet or other Windows applications.

D You plan to retire someday. (Or you're already retired.)

Now you can see better than ever exactly how your retirement fund and investments are doing.

The new investment portfolio view provides instant comprehensive analysis of your investments' performance and value. Choose the investing measures that mean the most to you, from at least 14 different options — including estimated income, ROI, percent yield, and much more.



And now it's much easier to enter new investment activity, too. Just fill out the new onscreen investment activity form. It prompts you for the specific information relevant to virtually any investment transaction.

Quicken upgrades following people:

E You love Quicken's speed and ease.

The new amount field calculator is radically different — and it's the most convenient onscreen calculator ever. Just type any equation (such as "2.75 + 4.95 x 1.08") directly into the Payment or Deposit column, and it enters the answer for you automatically.

And the new date field calendar makes date entry easier than ever, with no typing.

Plus: backup is automatic in Windows now as well as DOS.

F Your Quicken is more than two years old.

If you've been too busy to upgrade lately, you've been missing some very popular new features. Like QuickFill™.



Plus IntelliCharge™ electronic credit card statements. And the innovations in QuickZoom,™ financial reporting and investment tracking we've mentioned all build on literally hundreds of earlier new features and enhancements. Like loan amortization, financial planning calculators and better links to tax packages, to name just a few.

And learning new Quicken features is easier than ever, too — with new Qcards™ to guide you step by easy step.

G You don't (and won't) do Windows.

New Quicken 7 for DOS has its own way of doing just about everything we've mentioned for Windows, plus special features which DOS users in particular will appreciate. For starters, your graphs look better, work harder, and you can print them out, too.

New QuickZoom for graphs shows the "numbers behind the pictures." So you can press "enter" on the graph of your May expenses, for example, and zoom to a pie chart breakdown on them.

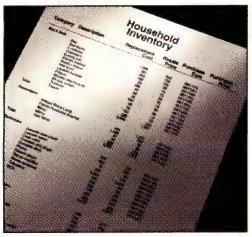


"Enter" again on any piece of that pie, and zoom to the transactions behind it. Yet another "Quicken easy" way to answer your questions fast!

To name just a few more items: Now you can save multiple budgets. And new Quicken 7 for DOS also remembers your last transaction so you can get to it in an instant. There's much more. We're as committed to DOS as you are.

H You can never be too organized.

Windows users: Introducing new Quicken Companion™ 2 for Windows — featuring the new Quicken Home Inventory.™ It organizes all your household possession records in one place, in about an hour. Just scroll through the "reminder list" and click on "your" items, keeping or changing the average replacement values as you go. Now you've got a complete insurance coverage report to help you make informed insurance decisions, and provide solid claim backup, too.

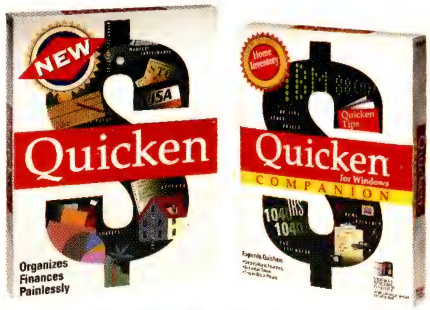


Quicken Companion also estimates personal taxes, provides online stock and mutual fund pricing, and includes expert tips for getting the most out of Quicken.

If you upgrade to Quicken 3 for Windows, be sure to get Quicken Companion, too.

I You like choosing from 3 special upgrade offers.

1. Get a $10 rebate on Quicken (and a $5 rebate on Companion) when you upgrade at your local store. Or . . .
2. Pay only $29.95* when you upgrade directly from Intuit. (Either way, your price should come out roughly the same.) Or . . .
3. Get both Quicken 3 and Companion 2 for Windows for just $49.95*. (This special offer only available when you upgrade directly from Intuit.)



No-risk 60-day money-back guarantee.

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1-800-624-8742

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*Plus $5.00 shipping and handling (US$11 in Canada, including GST)

Suggested retail prices: Quicken is $69.95 and Quicken Companion is $34.95

Special offers end 12/31/93 **Ad Code: PADAS**

New Canadian editions of new Quicken 7 for DOS and Quicken 3 for Windows are shipped to all Canadian addresses. New Quicken 4 for Macintosh is available now! If you're not delighted with any Intuit product, simply return it within 60 days for a full refund. Quicken is a registered trademark and Quicken Companion, Financial Calendar, Quicken Home Inventory, QuickZoom, QuickFill, Qcard, and IntelliCharge are trademarks of Intuit. Windows is a trademark of Microsoft, Inc. DOS, Windows and Mac feature sets vary. Foreign shipping additional. ©Intuit 1993.

DOS System Requirements: 100% IBM® compatible PC with 640 RAM, DOS 3.0 or higher, and a hard disk drive. Graphs require graphics card. Guaranteed to work with your printer or monitor, or your money back. **Windows System Requirements:** 100% IBM® compatible PC, 286 or higher (386 recommended), Windows 3.1, 2MB RAM and 5MB free on your hard disk. **Quicken Companion** requires additional 2MB free on your hard disk. Works with any printer or monitor supported by Windows 3.1. Quicken 7 for DOS and Quicken 3 for Windows are file compatible.

COLORADO TAPE BACKUP

Colorado Tape Backup vs. floppy disk stackup.

May We Suggest The Stack on the Right.



You need to protect your data. *With today's hard disk capacities backing up on floppy could take 80, 100, even 200 or more diskettes and several hours.* ■ *Colorado Memory Systems has a better way. Colorado Tape Backup.* ■ ***Your data is your most valuable asset.*** *Independent studies show that recovering lost data can take as long as 42 days, costing as much as $98,000*. And only 6% of businesses survive more than two years after major data loss.* ■ ***Colorado tape backup is the easiest and most reliable way to protect your data.*** *With dozens of awards and more recommendations by users, resellers, and editors than all other backup systems combined, nothing else stacks up to Colorado.* ■ ***Explore Colorado Tape Backup Solutions today.*** *Visit your dealer or* ***call 1-800-451-0897,*** *extension 722 for details.* ■



*Capacities from 120 MB to 4 GB***

COLORADO MEMORY SYSTEMS INC.

* Source: IDC. ** Capacity using data compression. © 1993 Colorado Memory Systems, Inc. All rights reserved.
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CIRCLE 073 ON READER SERVICE CARD

First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

■ **Easel down the Road**

Compaq Takes the Pen Plunge with $2,499 Concerto

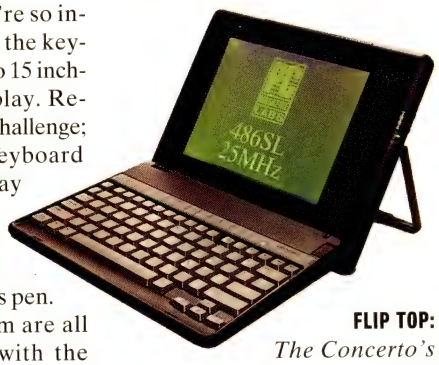
BY DON WILLMOTT

If you're sure that you'll never want to use a pen as a pointing device on your notebook PC, read no further. Compaq's new Concerto isn't a halfway, pen-optional system; its radical, easel-like design is pen-centric from top to bottom.

A guided tour of the Concerto takes a few moments. To set it up, you first flip the carrying handle over to turn it into the support that holds the system up. Then you push two buttons to let the keyboard flop down in front of you, revealing the screen beneath. Then, if you're so inclined, you can detach the keyboard and move it up to 15 inches away from the display. Reattaching it is a bit of a challenge; you have to coil the keyboard cable and hide it away just right.

Above the display is a door behind which lives the cordless pen. The guts of the system are all behind the display, with the floppy disk drive opening atop the display. All ports are hidden behind a sliding door on the back of the display.

Tired yet? The theory behind the design is that there are so many different ways to use the Concerto that it's a no-compromise system in terms of usability as well as power. It's meant to be a pen tablet, a traditional clamshell portable, and a decent desktop replacement all at the same time. It's functional in all these ways, but you may want to practice setting it up a few times in private before you try doing it in front of other people.



FLIP TOP: *The Concerto's handle converts into the support for the display.*

POWER SPECS

The system comes with a 25- or 33-MHz 486SL processor and 4MB RAM that can be expanded to 20MB. When closed, the whole thing measures 2 by 12 by 9 inches (HWD).

The Concerto weighs in at a slightly heavy 6.8 pounds with the keyboard and 5.2 pounds without it (its travel weight with the 5.25- by 3.25-inch AC adapter and power cords is 7.9 pounds).

The 25-MHz model comes with either a 120MB or 250MB hard disk; the 33-MHz version comes with the 250MB disk (Compaq is unspecific about

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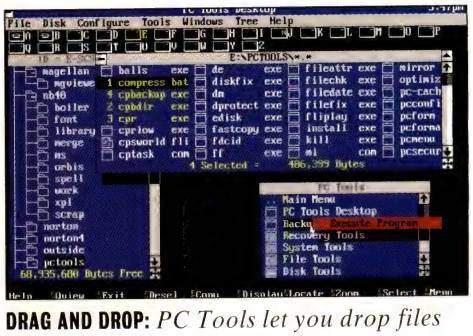
■ **Utilities for DOS Die-Hards**

PC Tools Has New Crash Recovery Features

BY EDWARD MENDELSON

Version 9 of PC Tools Pro for DOS adds to the file management, safety, and recovery utilities that have always been the strongest features of Central Point Software's $179.95 utility collection. No other utility package offers as many tools for maintaining your system and salvaging it when it fails.

But, unlike earlier versions of the package, the new one is no longer cluttered with miscellaneous notepads, keyboard macros, and fax software that swelled the feature list on the box but didn't help you maintain your system.



DRAG AND DROP: *PC Tools let you drop files on an icon for processing.*

In addition to improved DOS-based backup, disk-repair, and antivirus utilities, PC Tools now comes with a memory-resident program that saves everything in your computer's RAM at specified intervals and lets you return to the program and files you were using before a system crash. It also includes the best suite of hardware diagnostics available outside standalone system-reporting packages.

PC Tools Pro retains its familiar disk cache, defragmenter, directory management utilities, and the PC Shell file manager and program launcher, now renamed PC Tools Desktop, but it leaves out the ineffective calculators, communication, and remote-control programs in earlier versions. If you upgrade from an earlier version (for $49.95), the install program leaves these older utilities on your disk. But if you

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Compaq Concerto

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pricing of the higher-end models); and this is the first Compaq notebook to include PCMCIA slots, in this case two Type II (that can be used as one Type III). That's where your modem or network interface card goes.

Also included is a 3-year warranty and a carrying case.

POWER MANAGEMENT

An "instant on" feature lets you go into standby mode for up to a week, and the nickel hydride battery ensures decent battery life. In PC Labs' testing, the system lasted an impressive 6 hours 41 minutes with all power-management features turned on. Interestingly, you control power management, as well as screen brightness and contrast, with little buttons next to the display that you poke with the pen.

When the keyboard is attached to the display, it sits at a comfortable 10-degree slant that makes typing on the big, uncramped keyboard a pleasure. When detached from the display, the keyboard can still sit up, thanks to a door on the back that pivots around to prop it up.

But is the Concerto portable enough? At times, the setup can seem very large. When we set the system up and angled the screen for the best possible viewing, the Concerto was 15 inches from front to back, which may make you wonder how you would use it in the crowded coach section of an airplane. The answer is: with the front of the keyboard hanging off the tray table and your elbows potentially jammed into your seat back.

Compaq wants to promote the power of the pen, so along with including Windows for Pen Computing, Compaq improves the pen experience by including two software programs: Slate's PenPower for Excel and InkWare's NoteTaker (see First Look reviews of these products on page 39).

Penphobes will be happy to see that along with parallel, serial, and external monitor ports, Compaq has given the Concerto a mouse port, too, but no mouse or trackball is included with the system. To use a mouse with the system extensively would be somewhat foolish, given that you're paying for the Concerto's pen capabilities.



PEN-CENTRIC: *Leave the keyboard at home and use the system as a pen tablet.*

There's also a port that connects the Concerto to Compaq's optional FlexConnect Convenience port replicator.

The Concerto's thought-provoking design should make you ponder the way you compute in the office and on the road now, and how you expect to be doing it in a year or two. The trade-off for pen-centricity is the system's weight and its less than totally convenient easel design. But the detachable keyboard is an attractive concept, and if you're ready to take the pen plunge (and didn't rush out to buy a NEC UltraLite Versa), this is the system to do it with. □

FACT FILE

Compaq Concerto 4/33

Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269; 800-345-1518, 713-370-0670

List price: with 25-MHz processor and 120MB hard disk, $2,499.

In short: The Concerto's radical design dictates that you use a pen as a pointing device, at least some of the time. That issue aside, the system is powerful and fairly priced.

424 ON READER SERVICE CARD

■ **Illustration**

PainterX2 Adds Layering to Leading Paint Program

BY LUISA SIMONE

We've come to expect innovative technology from Fractal Design Corp., the company that brought natural media painting tools (like oil paints and charcoals) to Windows. And so it's no surprise to learn that Fractal Design Painter 2.0 now adds the ability to layer and manipulate mutiple floating selections to its already impressive list of features. The addition is literally that—a separate $149 program called PainterX2 that must be run in conjunction with Painter 2.0.

PainterX2 lets you use the standard frisket tools to select areas of a picture. But once clicked on by the new Floating Selection tool, these areas become separate objects that continue to float even when deselected. You can resize, rearrange, relayer, and retouch objects on an individual basis. Only Painter's native RIFF format can preserve floating selections. When exporting to other standard raster file formats, floating selections are understandably composited into the background layer.

Palettes make most of X2's functions easy to access. The Portfolio palette, for example, lets you catalog and retrieve floating selections with a simple click-and-drag motion, and the Floating Selections palette gives you control over an object's opacity and position in the stacking order. The other new functions—notably the ability to create painterly and transparent masks with the Generate Mask command and the Masking brush—are harder to master.



LAYERS: *The multiple images of the soccer player are all separate objects.*

In addition to floating selections, X2 enhances Painter 2.0 with new color management capabilities. Creating Color Sets lets you save and reuse colors across documents. Improvements to the fill options, specifically Cartoon Cel, Mask Threshold, and Lock-Out, let you color line drawings more efficiently.

Once professional illustrators see the effects possible with X2, they will consider this program a bargain at any price.

• List price: *Fractal Design PainterX2 for Windows, $149.* Requires: *Fractal Design Painter 2.0, 4MB RAM, 6MB hard disk space, Microsoft Windows 3.0 or later. Fractal Design Corp., 335 Spreckels Dr., Aptos, CA 95003; 800-297-2665, 408-688-8800, fax, 408-688-8836.*

Circle 428 on reader service card

Pen Software

NoteTaker: Computerize Your Casual Jottings

BY DON WILLMOTT

Pen computers have yet to live up to their promise as convenient replacements for legal pads and spiral notebooks, but programs like Ink Development's $195 InkWare NoteTaker start to make the electronic jotting of notes seem feasible.

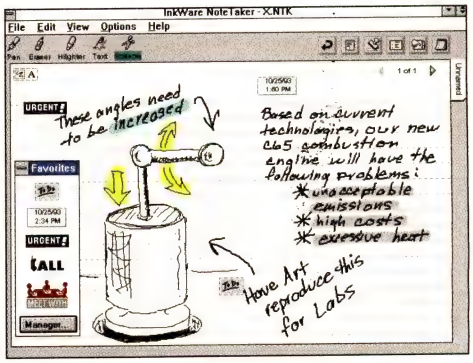
The program first came out under the PenPoint operating system in 1992 (First Looks, December 8, 1992). This new version runs under Windows for Pen Computing, and it's included with Compaq's new Concerto notebook (see page 37).

NoteTaker isn't really meant to recognize handwriting and convert it into data that's usable in a word processor. Rather, it preserves your notes as graphic images and stores them away for later retrieval. Handwriting recognition is available, but you only use it for creating keywords that you can search for (you can also type in text).

Along with several different pen styles, a highlighter (it shows up as yellow on a color screen), and an eraser, NoteTaker has a scissors tool that helps you cut and edit your handwritten notes.

More interesting and very useful are the stamps you add to your notes and then search for later. There are "Urgent," "To Do," "Reminder," and "Call" stamps, along with a date and time stamp. By adding such stamps to your notes, you can use NoteTaker's List tool to sort through everything you've scrawled so that all the pages stamped "Urgent" or all the notes you took on December 10 float to the top. According to Ink Development, an average page of notes is about 6K in size.

If you don't like the default legal-style pages, you can create your own backgrounds, varying line width and style, margins, and shading. NoteTaker lets you import graphics and export note pages in a variety of formats, including .BMP and TIFF, so if you sketch a great idea you can work on it further elsewhere.



SCRIBBLE: *NoteTaker simulates paper.*

The biggest problem with NoteTaker (and any pen application) is that you may find that your already bad handwriting becomes illegible, at least until you learn to control the pen and its various widths. As for the tap-tap-tapping sounds you make as you write on a pen-based system, you'll have to decide for yourself if that's socially acceptable in the places where you take notes.

- List price: *InkWare NoteTaker, $195 (included with Compaq Concerto).* Requires: *4MB RAM, 5MB hard disk space, Windows for Pen Computing 3.1. Ink Development Corp., 1300 S. El Camino Real, #201, San Mateo, CA 94402; 415-573-7775, fax, 415-573-5167.*

Circle 426 on reader service card

Pen Software

PenPower Brings Pen Control to Windows

BY DON WILLMOTT

When you run a Microsoft application like Word for Windows or Excel under Windows for Pen Computing, the pen in your hand is not only a mouse replacement but also a data-entry tool and an editor.

But does Windows for Pens provide enough pen functionality? Slate Corp. says no, and its $99 series of PenPower add-ins give additional pen power to the most popular Microsoft applications. You can get PenPower for Excel 4.0 and 5.0 now, with versions for Word for Windows 6.0 and PowerPoint 4.0 coming.

We ran PenPower for Excel 4.0 (which is included with the Compaq Concerto) and found that with a little practice, you can indeed speed up certain parts of your spreadsheet work. Picking up a pen and putting it back down is a highly unnatural act for avid mouse users, but it's worth it for spreadsheet annotations and markups, range selection, and quick cell data entry.

PenPower also lets you map commands and formulas to simple gestures. If you want to add a column of numbers, for example, you can just write an S over a cell and circle it.

The included Formula Builder, a small calculatorlike window, lets you work on spreadsheets when you don't have a keyboard. You tap on numbers to enter them as data, use the Functions button to scroll through a list of Excel functions, and use the Operators button to build the formula.

PenPower's gestures do help you hop around your spreadsheet with speed, and the program certainly succeeds in its goal of bringing more pencentricity to Excel than Windows for Pens can alone.

- List Price: *PenPower for Excel, PowerPoint, or Word for Windows, $99 each (Excel version included with Compaq Concerto).* Requires: *4MB RAM, Windows for Pen Computing 3.1. Slate Corp., 15035 N. 73rd St., Scottsdale, AZ 85260; 800-826-8071, 602-443-7322.*

Circle 427 on reader service card

InkWriter: EO Ink Editing

Slate's PenPower for Microsoft Word for Windows isn't the only tool for turning handwritten notes into surprisingly editable text. If you have an EO Personal Communicator or another PDA running the PenPoint operating system, you can edit your hand-scrawled electronic notes with aha! Software Corp.'s $249 InkWriter. This innovative program lets you rearrange, edit, erase, rescale, highlight, and even search on handwritten (nonrecognized) text. Using its "SmartInk" technology, InkWriter can automatically wrap and rewrap text, closing up gaps when you erase a word. It also has handwriting recognition that you can activate either as you write or after you've finished. InkWriter also has a shape recognizer that can sharpen the edges of the squares you draw or smooth the curves of your circles. You can rotate your drawings, fill them in with patterns, and annotate them in several fonts. Contact aha! Software at 1685 Plymouth St., Mountain View, CA 94043; 800-242-7638, 415-988-2080; fax, 415-988-2081.—*DW*

PC Tools Pro

CONTINUED FROM PAGE 37

never used them before, you won't miss them from the new version.

RECUPERATOR

The most spectacular addition to the package is the Central Point Recuperator (CPR), which saves everything in your system and video memory to disk and optionally restores it after a crash. CPR can save your DOS or Windows system state after specified idle intervals or as soon as you press a hotkey.

CPR isn't designed to be used as a quick shutdown and resume program like the feature built into some laptops or software equivalents—for example, Engram's Stop & Go! or Binar Graphics' Fantastic Recall—which all save your system when you decide to shut down. CPR lets you continue work after a save, so you can recover your system when disaster strikes without any warning. Before it restores your system to an earlier state, it checks the File Allocation Table to see if your disk structure has changed to the point where a restore would be ineffective or dangerous, and alerts you to the dangers.

The first version of CPR suffers from minor glitches, but needs only 6K of DOS memory and is safe enough to make it better than no protection at all when you use software that crashes often. On one test system with a bus mouse, the mouse was always unavailable in Windows after a recovery, although it worked under DOS. Closing all files and rebooting immediately after recovery brought the mouse back to life.

CPR locked up a computer with a caching SCSI controller when it first attempted to save the system state, but worked after fine-tuning the installation. It's wise to try test saves from DOS and Windows before relying on CPR for emergency rescue.

PC Tools' other repair programs are enhanced for speed and compatibility. DiskFix, Central Point's counterpart to the Norton Disk Doctor, now works effectively with both Double Space- and Stacker-compressed drives. The defragmenter now defragments files on compressed drives (DOS's DBLSPACE/DEFRAG command does not) as well as on normal drives. The FileFix program now repairs WordPerfect 6.0 files along with other standard formats.

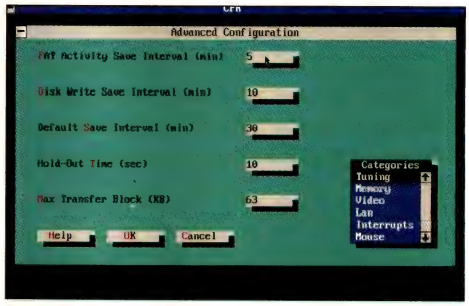
The Disk Editor remains a powerful tool for experts who need to repair or alter directories, file allocation tables, and other deep structures of their disks. All the PC Tools disk utilities, like those in The Norton Utilities, now work with the largest available drives. A new feature lets DiskFix and the defragmenter send messages to the network administrator when the programs detect a major error.

The undelete program is a more advanced version of the undelete that comes with MS-DOS 6.0, complete with a full-screen option and tools for manual file recovery. It's a close match for the undelete in The Norton Utilities.

Unlike Norton's separate system reporting and hardware testing programs, PC Tools' system information is an integrated testing and reporting utility that can rival standalone DOS-based diagnostic packages like The RenaSonce Group's InfoSpotter or Dariana's System Sleuth Professional. It tests low-level motherboard functions and includes complex RAM tests found in few standalone programs.

However, unlike the best separate packages, it doesn't give accurate reports on hardware interrupts and won't even try to list port addresses used in your system, so you can't rely on it to warn you about conflicts that might occur when installing add-in boards.

Central Point Backup, already one of the best available, looks almost identical to earlier versions, but uses a more logical file selection and is notably faster when used with SCSI tape drives. It still lacks command-line restores.



RESCUE: *The CPR program restores the state of your system after a crash.*

TASK-SWITCHER

The small, elegant task-switcher introduced in the last version now lets you specify a task that the system will switch to after a specified period of idle time, and it remembers the list of tasks from a previous session for instant loading. It lacks a clipboard for transferring data between tasks, and we experienced occasional lockups when unloading it from memory, but it's still the best small-scale program of its kind.

PC Tools' RAMboost helps optimize other memory managers like QEMM or the built-in manager in DOS 6, but doesn't manage memory by itself. Unlike MemMaker and some other memory management programs, it detects changes in CONFIG.SYS or AUTOEXEC.BAT and reoptimizes your system the first time you reboot after you have changed the configuration.

In testing, it locked a test machine until QEMM's DOS-Up feature was removed, and until we edited RAMboost's configuration file, using commands that were documented only in a text file, it silently removed a crucial line from AUTOEXEC.BAT.

DRAG AND DROP

The PC Tools Desktop file manager and application launcher allows drag-and-drop from the file and directory lists to a limited number of applications, notably Central Point Backup. You can customize the menus to include programs on drop-down menus or on a separate application menu. As in The Norton Commander, an optional DOS-like command line lets you run programs that aren't on the menu.

PC Tools Pro suffers from minor glitches, like a command-line CHKDSK-style FILECHK utility that gives different disk-fragmentation reports from the defragmenter itself. But overall, this is a mature and solid product, with innovative features that can't be matched by other utility packages.

Symantec's The Norton Utilities remains the premier set of DOS-based disk utilities, but PC Tools Pro defends your data with a number of new weapons that Symantec doesn't offer in its package, and comes in the same box with backup and antivirus programs that Symantec sells separately.

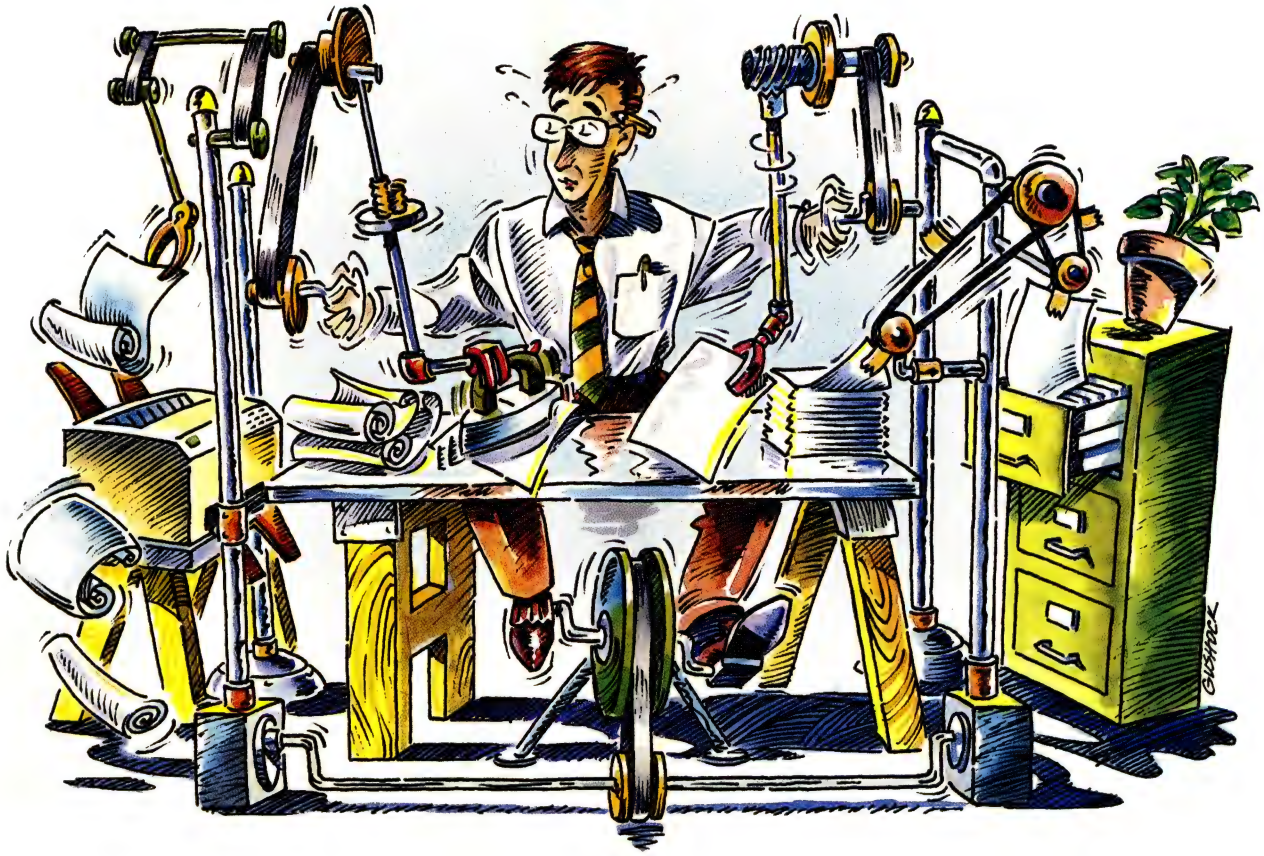
- List price: *PC Tools Pro 9.0 for DOS, $179.95; upgrade, $49.95. Requires: 640K RAM, up to 8MB hard disk space, DOS 3.31 or later. Central Point Software, 15220 N.W. Greenbrier Pkwy., #150, Beaverton, OR 97006; 800-964-6896, 503-690-8090l; fax, 503-690-5187.*

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FIRST LOOKS PLUS

From December 6 through December 10, you can go online to download a demo of PC Tools Pro or to discuss the program with Edward Mendelson and Central Point product manager Tom Darnall and development manager Ken Whittington. Type GO EXEC from any CompuServe prompt.

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■ Notebook PCs

Gateway's ColorBook and HandBook: Two for the Road

BY BRAD GRIMES

When you buy a PC from Gateway 2000, you expect quality at a reasonable price. But no expectations can prepare you for the company's newest 486-based notebooks and subnotebooks. Besides being as portable and full-featured as other notebook PCs, they have quality displays that you'd probably be willing to pay more for if you were buying from other vendors. When it comes to actual video performance, however, you're closer to getting what you pay for.

COLOR AT THE RIGHT PRICE

Before the arrival of Gateway's newest 5.7-pound ColorBooks, you had to put up with washed-out color if you wanted a color notebook for under $2,000. The $1,995 ColorBook 486SX-25's 9.4-inch dual-scan color display is so good that you might think you accidentally got an active-matrix display. One drawback of the system, though, is the 80MB hard disk that comes standard with the $1,995 model—it really isn't large enough to support a complete Windows environment. The $2,395 ColorBook 486SX-33 and the $2,695 ColorBook 486DX-33 both come with 170MB hard disks and still represent quality color at an affordable price. In every model, the IDE hard disk is removable, so upgrading the 486SX-25, or swapping drives in all three models, is easy. Drives, however, are not hot-swappable, so you must turn off your system to change hard disks.



A NEW PAIR OF GATEWAYS: *The ColorBook 486SX-25 and its mini companion, the HandBook 486SX-25.*

The ColorBook comes with a miniature trackball that slides out from underneath the front of the keyboard. For such a small device, it gives you exceptional control over the cursor, but it requires manual dexterity. There are also two Type II PCMCIA slots for connecting peripherals, and a memory module compartment for upgrading the standard 4MB of RAM.

The $1,495 HandBook 486SX-25 is a subnotebook with a lot going for it. The 7.9-inch backlit LCD screen is exceptional for a system of the 2.9-pound HandBook's size and price point. It's also equipped with an 80MB hard disk, a 9-pin serial port with a cable for connecting serial devices, and a Type II PCMCIA slot. A 40-MHz 486DX2-based HandBook comes equipped with a 130MB hard disk and costs $1,995.

The HandBook's built-in pointing device, known as EZ Point, resembles the TrackPoint II of an IBM ThinkPad but is placed in the upper right-hand corner of the keyboard. Since the mouse buttons are on the front of the HandBook, the EZ Point system is actually quite useful because the HandBook's small size makes it possible to control EZ Point and its buttons with one hand. Like all subnotebooks, the HandBook suffers from keyboard cramping, but not so much that it's unusable. It is full-featured and has a key travel distance that provides good response.

An external floppy disk drive connects through a miniature parallel port. (An adapter is included for connecting to regular-size parallel devices.) Oddly enough, the AC adapter for the small 1.6- by 9.75- by 5.9-inch (HWD) HandBook is significantly larger than ColorBook's. Total travel weight is about 4.75 pounds, but you'll wish the AC adapter weren't so bulky.

SUSPEND AND RESUME

Both the ColorBook and the HandBook come with a suspend and resume button, but no separate on/off switch. In the case of the ColorBook, you can program the button to operate as an on/off switch. The HandBook, however, doesn't have this programmable feature—the button is always a suspend and resume button. If you need to reboot the HandBook you'll have to hit Ctrl-Alt-Del, and if you want to completely shut it down, you have to remove the battery.

On the PC Labs benchmark tests, both machines performed well on the processor and disk tests but neither turned in good video or Graphics Winmark scores. Thanks in part to its hard disk, the ColorBook scored well on the Winstone test suite of Windows applications. All the new Gateway notebooks use Intel processors with power management features built in, resulting in better-than-average battery rundown scores.

- List price: *Gateway 2000 ColorBook 486SX-25, with 4MB of RAM, 80MB hard disk, MS-DOS 6.0, Microsoft Windows 3.1, $1,995; Gateway 2000 HandBook 486SX-25, with 4MB of RAM, 80MB hard disk, MS-DOS 6.0, Microsoft Windows 3.1, $1,495. Gateway 2000 Inc., 610 Gateway Dr., North Sioux City, SD 57049; 800-846-2000, 605-232-2000; fax, 605-232-2023.*

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Benchmark Tests: Gateway 2000 ColorBook 486SX-25 and HandBook 486SX-25

Both the Gateway 2000 ColorBook 486SX-25 and the Gateway 2000HandBook 486SX-25 held their own on theDOS processor and disk tests. They stumbled, however, on the video and Graphics WinMark tests. We used PC Magazine Labs' PC Bench 8.0, WinBench 4.0, and Winstone 94, Version 1.0, to test the performance of the two systems.

Higher scores represent better performance.	Processor	Video	Disk	DOSmark	Graphics WinMark (millions of pixels per second)	Disk WinMark	Winstone	Battery Rundown (hours: minutes)
AST Bravo NB 425sColor Plus (SX/25)	13.1	2,393	457	227.7	2.3	295	6.3	1:14
Gateway 2000 ColorBook 486SX-25	17.2	758	452	242.9	1.3	356	11.8	2:41
Gateway 2000 HandBook 486SX-25	16.5	701	492	237.3	1.5	399	N/A	2:14
TI TravelMate 4000E WinSX/25 Color (SX/25)	18.7	2,105	518	300.4	2.5	416	9.9	2:13

N/A— Not applicable: We were unable to perform this test on the HandBook 486SX-25.

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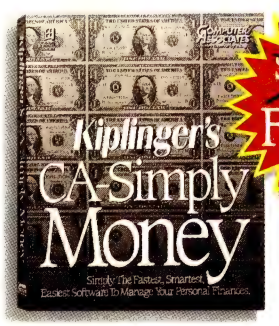
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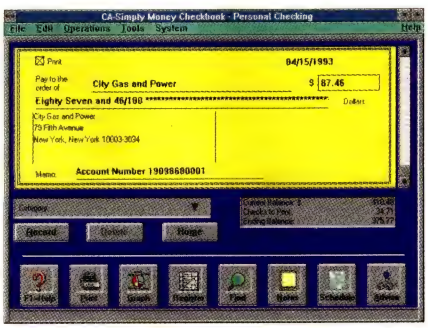
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■ PCs

Inmac's New $2,500 Insignia PC Is Built by IBM

BY BRUCE BROWN

Inmac Corp.'s newly implemented arrangement with IBM gives mail-order customers the chance to buy top-level manufactured PCs at mid-level prices. IBM's Austin Industrial Business Center builds the Insignia PCs based on design specifications from Inmac, while Inmac is responsible for product sales, service, and support. The deal helps to lessen the concern some buyers may have about the quality they'll get if they purchase a computer via mail order.

There are currently four Insignia systems, all of which come standard with a four-drive-bay, low-profile case, 4MB RAM, a 3.5-inch, 1.44MB floppy disk drive, 145-watt power supply, integrated graphics video accelerator circuitry, a 14-inch, 1,024 by 768 noninterlaced monitor, a mouse, MS-DOS 6.0, Windows 3.1, QAPlus, and Lotus Organizer. All but the 450SL are upgradable to Pentium-level CPUs using a ZIF socket.

STARTING AT $1,299

The least powerful Insignia system is the $1,299 450SL, with an IBM 50-MHz 486SLC2 CPU and a 120MB hard disk. The other three models all come with Intel CPUs and 170MB hard disks, including the 433P ($1,749 with a 33-MHz 486DX CPU), the 450P ($2,099 with a 50-MHz 486DX2), and the tested 66-MHz, 486DX2-powered 466P which starts at $2,199. The $2,488 Insignia Professional test system with a 256K external RAM cache was upgraded to 8MB RAM.

In addition to the standard units, Inmac sells customer-specified configuration PCs with their Built to Order system. When you order a computer with upgrade options, Inmac passes the order on to the IBM plant, which assembles the hardware, installs all standard and any optional software, tests the system, and ships it directly to you.

In addition to different processor levels, customer upgrade options include RAM (up to 64MB on all units except the 450SL, which is limited to 32MB), hard disks up to 540MB, different floppy disk drive configurations, a faster video card, larger monitor, network adapters, fax/modems, multimedia components, and a selection of major software application and utility packages.

PERFORMANCE LEVELS

Assuming the tested model is indicative of the other level Inmac machines, the Insignias will be overall average performers, based on PC Magazine Labs benchmark testing. The Insignia 466P review unit had faster-than-average processor and DOSmark scores but somewhat below-average WinMark and Winstone scores.

Looking inside the Insignia's 4.5- by 16.5- by 17.4-inch (HWD) case, you'll find an IBM-labeled motherboard with a ZIF processor socket, four SIMM memory sockets, and five 16-bit ISA expansion card slots (two for half-length and three for full-length cards). With all standard peripheral interfaces integrated on the motherboard, all expansion slots are empty in the standard configuration.



INSIGNIA PROFESSIONAL: *Four models.*

None of the Insignia's expansion slots has local bus extensions, but the on-board video circuitry is Cirrus Logic's SVGA Local Bus version, including a CL GD5428 Windows Accelerator, 1MB DRAM, 640-by-480 True Color with 16.8 million colors, and a maximum resolution of 1,280 by 1,024.

Consistent with the overall design of this machine, Cirrus Logic's video yields a good price/performance ratio: It's not super fast, but you don't have to pay a lot for it. The Insignia monitor, made by CTX, has a maximum resolution of 1,024 by 768 at 60 Hz, so you'll probably run it at 800 by 600 resolution, more fitting for a 14-inch monitor and flicker free with its higher 70-Hz vertical refresh rate.

FULL SUPPORT

Inmac's service and support program for the Insignia PC series includes a one-year parts and labor warranty with next-day on-site service, 24-hour toll-free telephone and fax technical support forever, and a 30-day money-back guarantee. On-site service is also provided by Inmac's own service teams.

While not a screamingly fast system, the Insignia is a fine, fairly standard machine. By taking advantage of IBM's manufacturing assembly and testing expertise, Inmac can concentrate on what it does best: sell and support. The arrangement between the companies looks like a good blend of quality and price.

• List price: *Inmac Insignia Professional 466P, with 8MB RAM, 256K external RAM cache, 170MB hard disk drive, MS-DOS 6.0, Microsoft Windows 3.1, Diagsoft QAPlus, Lotus Organizer, $2,488. Inmac Corp., 2465 Augustine Drive, P.O. Box 68031, Santa Clara, CA 95052-9941; 800-446-6224; 408-727-1970; fax, 800-547-5444.*

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Benchmark Tests: Inmac Insignia Professional 466P

The Inmac Insignia Professional 466P performed better than the average 486DX2/66-based PC on processor, video, and disk tests, but fell slightly behind on the Graphics WinMark and Disk WinMark tests. The Cirrus Logic video subsystem is a good buy but doesn't necessarily make for a Windows powerhouse.

We used PC Magazine Labs' PC Bench 8.0, WinBench 4.0, and Winstone 94, Version 1.0, to test the Inmac Insignia Professional 466P's performance.

Higher scores represent better performance	Processor	Video	Disk	DOSmark	Graphics WinMark (million pixels per second)	Disk WinMark	Winstone
Compaq ProLinea (DX2/66)	34	6,200	958	565.7	7.7	735	46.5
Compaq Deskpro/M (DX2/66)	47.1	3,207.10	1,016	677.8	9.8	941	58.8
IBM ValuePoint (DX2/66)	38	5,313	1115	628.1	15.5	992	50.4
Inmac Insignia (486DX2/66)	42.32	3,868.67	871	620.47	8.09	787	38.5
486DX2/66 average	39.7	3359.2	1050.32	592.67	9.5	861.36	49.5



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■ Preview

No Big Surprises in Toshiba's First Subnotebook

BY DON WILLMOTT

Toshiba, long a leader in notebook PC technology, has finally entered the subnotebook market. But rather than break new ground in the way that Hewlett-Packard's OmniBook did, the $2,599 Toshiba Portege T3400 is a surprisingly conservative system, designed to have the broadest possible appeal.

That's not to say it's bad. On the contrary, the late prototype model we previewed is a real traveler's friend, weighing just 4.1 pounds in its 8.4-inch monochrome display version (4.4 pounds with a bright, 7.8-inch active-matrix color screen that raises the price to $3,999) and measuring 1.7 by 9.9 by 7.9 inches (HWD).

The Portege is built around a 33-MHz SL-enhanced 486SX processor, with power-saving features to help out battery life. The system includes 4MB of RAM expandable to 20MB, a 120MB hard disk, an external floppy disk drive (if you don't need it, you don't have to travel with it), and one Type II PCMCIA slot.

One of the first things that catches your eye on the Portege is the IBM ThinkPad–like pointing device, here called AccuPoint, lodged in the center of the keyboard between the G and H keys. Its buttons sit in front of the keyboard. If you like the ThinkPad's TrackPoint, you'll like AccuPoint, too. If you don't, you can always plug in a mouse. The keyboard itself is quite comfortable; Toshiba has done a good job of avoiding the kind of excessive key crowding that so many subnotebooks suffer from.



TRAVELER: *Weighs in at 4.1 pounds.*

Video performance should be helped by Toshiba's inclusion of a VL local-bus graphics adapter. The Portege is also the first Toshiba portable to come with videocamera-like lithium-ion battery technology. Because the unit we saw was a prototype, we didn't test for battery rundown, but Toshiba claims you will get 3 hours of use with the color screen and 4 hours with the monochrome display.

Along with DOS and Windows, the Portege also comes with Traveling Software's CommWorks, a five-in-one communications utility. The system has a 3-year warranty.

If the Toshiba Portege lives up to its battery life claims, it's destined to be a hot seller, despite the slightly intimidating price tag. This notebook sets out to prove that these days, you can get a lot of work done with just 4 pounds of computing power in front of you.

• List price: *Toshiba Portege T3400 with 4MB RAM, 120MB hard disk, and monochrome screen, $2,599; with active-matrix color screen, $3,999. Toshiba America Information Systems Inc., P.O. Box 19724, Irvine, CA 92713; 800-334-3445, 714-583-3000.*

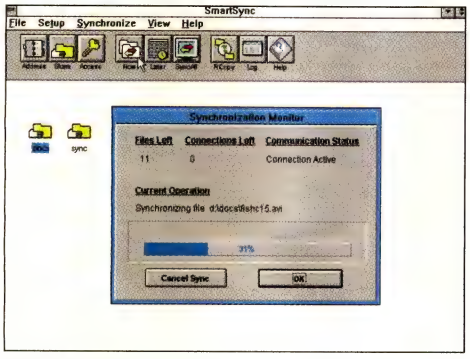
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■ Windows Utilities

SmartSync: Easy File Coordination

BY STAN MIASTKOWSKI

These days, many of us find ourselves working on an office PC, on a home system, and on a portable computer while traveling. Nomadic Systems' SmartSync takes the hassle out of coordinating multiple copies of files, making sure that you're using the most current version, no matter where you're working. This $169.95 Windows utility takes a big chunk of system resources but makes up for it with versatility and data security.



MULTI SYNC: *Automatically update like-named files on multiple PCs.*

At first glance, SmartSync looks a lot like a file transfer utility. Indeed, SmartSync does let you hook up two systems, search among directories, and transfer files between them. But there's much more. SmartSync isn't really designed for keeping entire computers synchronized. During setup, you specify one or more directories that you want to keep synchronized (a directory dedicated to a specific project, for example).

SmartSync lets you use direct (serial or parallel) connections, modems, or even floppy disks to keep your files synchronized on multiple systems. Instead of just keeping track of the times and dates of like-named files on different systems, SmartSync keeps track of incremental file changes. Because the product just transfers changes, it saves time. In order to do this, though, SmartSync needs to be running in the background whenever you're using systems that you want to synchronize. This requires running Windows 386 Enhanced mode, and it can affect performance.

Syncing two systems is a simple matter of clicking on an icon. You can perform the synchronization immediately or schedule regular connections. Cables aren't included, but you can order them directly from Nomadic Systems. Creating sync floppies is handy, especially for syncing files between home and office PCs. But SmartSync really shines at modem transfers, both with standard and cellular connections. If the connection breaks, SmartSync picks up again where it left off as soon as you reconnect.

SmartSync has numerous safeguards, including optional passwords. If you decide that you'd rather work with the prior version of a file you've synchronized, there's a single-level undo that will take you back. And SmartSync's especially clever if you try to synchronize files that have been changed on both PCs. A flashing exclamation point indicates a file conflict, and you're given the choice of aborting, overwriting one of the files, or saving both copies.

• List price: *SmartSync, $169.95.* Requires: *4MB RAM, 4MB hard disk space, Microsoft Windows 3.1. Nomadic Systems Inc., 650 Castro St., #410, Mountain View, CA 94041; 415-335-4310; fax, 415-968-8300.*

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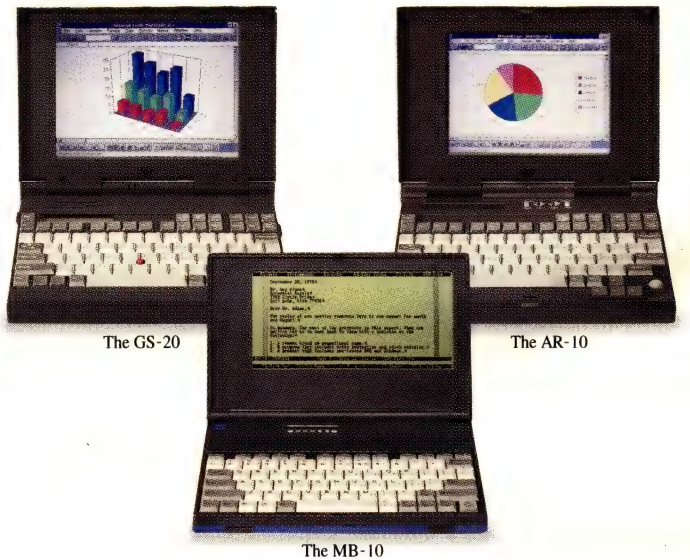


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Graphics

Visio Upgrade Has an OLE 2.0 Connection

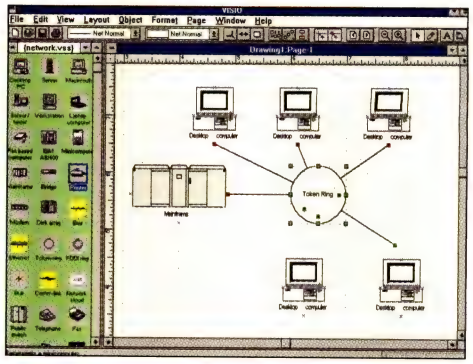
BY LUISA SIMONE

Last year, Visio helped to define a new class of graphics software: diagrammatic drawing programs. Visio's drag-and-drop stencils allow nonartists to create things like flowcharts, network schematics, and business forms. Version 2.0 of this $299 program proves that Shapeware Corp. still has its finger on the pulse of the average business user. Instead of adding new drawing tools, Visio 2.0 concentrates on the related issues of integration and efficiency.

The big news here is Visio's support of OLE 2.0. Visio can function as an OLE client, but its real power is in its role as a server that can handle both in-place editing and drag-and-drop document creation across applications. In-place editing seamlessly integrates Visio with other programs because it allows Visio's own menus and toolbars to temporarily replace the controls of the client application. During our testing, we successfully used in-place editing with Microsoft Publisher, an entry-level desktop publishing program.

But be warned: Visio's advanced OLE functions will only work with those programs that fully support Version 2.0 of OLE, and at this moment partial implementations are the rule rather than the exception. Until OLE 2.0–compliant products are available, much of Visio's functionality will be a promise rather than a reality.

Surprisingly, there is only one new drawing function in Visio 2.0: a distribute command that lets you position objects equidistant from one another. But using the original drawing tools is easier than ever thanks to improvements in the program's interface. For example, right-clicking an object now brings up a context-sensitive menu. And frequently used commands such as arrow endings and drop shadows can now be accessed from the toolbar.



DRAWING: *Reshape objects with control points.*

Behind every object in a Visio drawing is a spreadsheet called a ShapeSheet that controls the object's behavior as well as its appearance. New ShapeSheet functions add special control points to Visio objects that, in turn, let you drag out smart connectors from existing elements or reshape an object in specific ways. For example, a clock drawn with Visio can be reset by dragging control points for the hour and minute hands.

- List price: *Visio 2.0, $299 ($129 through December); upgrade, $79.* Requires: *4MB RAM, 5MB hard disk space, Microsoft Windows 3.1. Shapeware Corp., 1601 Fifth Ave., #800, Seattle, WA 98101; 800-446-3335, 206-521-4500; fax, 206-521-4500.*

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Data Compression

DoubleTools Augments DOS 6's DoubleSpace

BY SHERYL CANTER

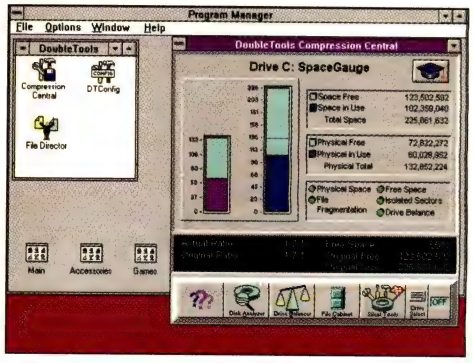
Addstor's DoubleTools for DoubleSpace is a set of user-friendly utilities for users of DOS 6's DoubleSpace. Priced at $99.95, DoubleTools relieves compression anxiety through its graphical, menu-driven interface and extensive on-line help.

There are three major components: Compression Central, File Director, and the DOS-based RTOOL (Rescue Tool) utility for disaster recovery. Compression Central and File Director are both Windows apps.

Compression Central is a suite of tools for managing compressed drives. The Space Gauge shows the amount of free and used disk space and lets you move allocated space between compressed and uncompressed drives. The Disk Analyzer tells you how fragmented your disks are, and it displays a scatter plot of file size versus compression ratio. Highlighting areas of interest and clicking with the mouse on the File Cabinet will display the names of the files involved. The Drive Balancer brings the estimated compression ratio in line with the actual compression ratio in order to ensure that DOS knows how much free space you *really* have.

There's also a group of background-loadable utilities. Collectively referred to as "Silent Tools," they include Check Disk, Disk Defragger, and Scan.

The File Director helps you create compressed files on floppy disks.



GAUGE: *See how much disk space is left.*

DoubleTools installs easily, but the dialog box labeled "Replace DoubleSpace Driver" may give you pause. It lets DoubleTools replace the Microsoft driver with its own, giving you access to some enhanced features. The Addstor driver is more easily loaded high because it's broken into pieces. It also allows you to automount removable media, such as compressed floppy disks, and is required for using Silent Tools.

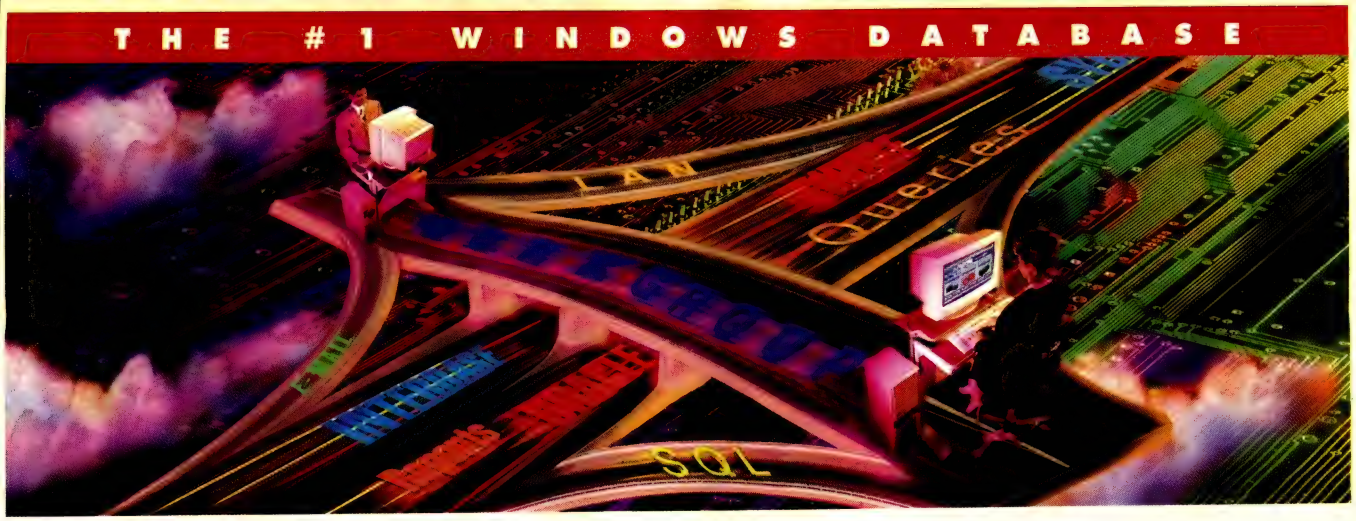
There are problems with the driver, however. If you load it high (the default), and defragment your hard disk, your system will crash. To avoid this, you must prevent the driver from loading high by creating a file on your host drive called ADDSTOR.INI. It should contain just one line: NOUMB.

Another problem crops up if you use a RAM drive along with the Addstor driver. A ghost drive appears after what should be your last drive. If you attempt to write to it, say good-bye to your hard disk. Addstor is trying to identify the cause of the ghost drives.

DoubleTools is not without its problems, but the difficulties are easily avoided. And you don't need the Addstor driver to take advantage of the graphical disk management tools.

- List price: *DoubleTools for DoubleSpace, Version 1.01, $99.95.* Requires: *2MB RAM, 2.5MB hard disk space, MS-DOS 6.0 or higher, Microsoft Windows 3.1. Addstor Inc., 1040 Marsh Rd., Menlo Park, CA 94025; 800-732-3133, 415-688-0470; fax, 415-688-0466.*

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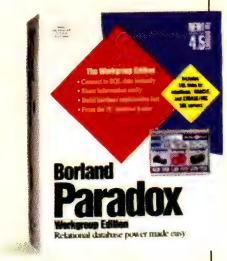


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■ Image Editing

Composer Challenges Artists With Incredible Effects

BY LUISA SIMONE

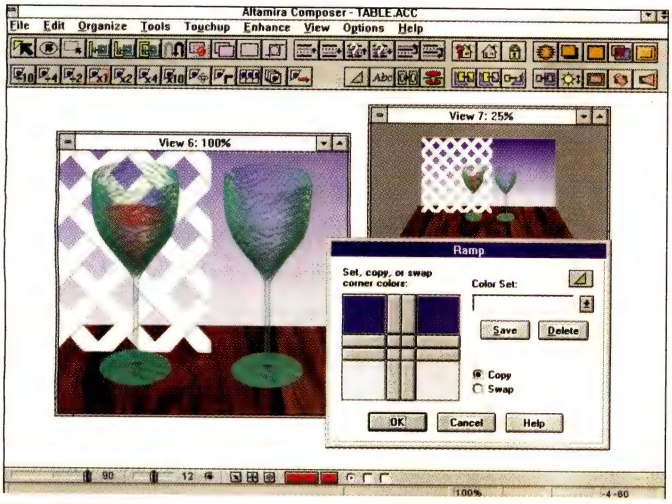
When Marcelino de Sautuola first discovered the wall paintings in the caves of Altamira he knew he was looking at the invention of art by prehistoric man. In honor of its namesake, Altamira Composer seeks to reinvent the art-making process for modern-day artists. While this $795 image-editing program is raster-based, it looks and feels very much like an object-oriented drawing program.

While other programs have grafted object layering onto traditional paint functions, Composer is built entirely around the idea of objects. So you can't simply open a file, grab a paintbrush, and start making marks. Instead, you must create an object, either by importing a picture in a standard file format (such as .BMP, JPEG, Photo-CD, or TIFF) or by creating an object from scratch by using one of the geometry tools.

The emphasis on objects—rather than on painting—is evident at every level. So instead of a standard magic wand to select similar color areas, Composer offers the Color Lift tool that literally generates a new and separate object based upon similar colors in the current image.

ITS BEST, ITS WORST

At its best, Altamira's object style lets you create some spectacular effects. You can layer what look like irregularly shaped objects and even control the transparency of the overlay. More impressively, you can map one object's characteristics onto another object. For example, you can create a gradient fill, sculpt a contoured sphere with the radial sweep function, and then map the intensity values of the sphere onto a separate object. The results, which are photorealistic three-dimensional shadows and highlights, would be difficult to achieve with a conventional painting program.



SEE-THROUGH: *The two glasses in this Altamira Composer composition are realistically transparent.*

At its worst, however, Altamira's object fanaticism make some functions awkward to use. For example, gradient fills must first be created as separate objects, rotated manually for directional fills, and then specifically mapped to the target object as a texture. It sounds like extra work because it *is* extra work.

Once you've become accustomed to treating paintings like objects, you'll find Composer to be a truly flexible program. Configuration options for many of the tools can create wonderful painterly effects. For example, by choosing different colors and line widths for the starting and ending positions of an open spline, you can create a brushstroke effect.

There is no lack of image editing or special-effects filters such as Blur, Dodge and Burn, Relief, or Clone. Object-manipulation functions, like Barrel, Vortex, and Schmudge, produce excellent 3-D simulations and warps.

In addition, you can create Libraries to store and organize frequently used images. Specialized tools for layering, alignment, and grouping functions let you determine the relative position of objects quickly and precisely.

Our one big complaint concerns Composer's idiosyncratic interface. Keeping track of the current object is difficult in a complex composition because Composer doesn't display the standard Windows selection handles. And you'll have to rely on pop-up labels to identify the 180 icons that fill the toolbar. In the course of testing Composer we ran into only one notable problem. Memory shortages were caused by Composer's habit of storing all object transformations in memory.

Evidence suggests that prehistoric cave paintings were produced by specialists—shamans and magicians wise to the ways of the magic image. Altamira Composer is a revolutionary program that should be used only by professionals who have been intiated into the rites of advanced image making.

• List price: *Altamira Composer for Windows, Version 1.0, $795 (introductory price through December 1993, $495).* Requires: *8MB RAM, 20MB hard disk space, Extended VGA (32,000-color) adapter, Microsoft Windows 3.1. Altamira Software Corp., 150 Shoreline Hwy., Suite B27, Mill Valley, CA 94941; 800-425-8264, 415-332-5801; fax, 415-332-5804.*

Circle 431 on reader service card

■ The Technology Of Transparency

The hot news in image editing is object layering—the ability to stack and reshuffle irregularly shaped raster pictures. Altamira Composer has even trademarked a phrase—Dynamic Alpha—to describe the technology. It's an apt moniker, because it's the alpha channel that makes object layering possible.

Typically, full-color raster images contain three channels: one each for red, green, and blue. All the programs that support object layering include a fourth—or alpha—channel. But instead of using the alpha channel for color information, they reserve it for transparency information. The objects that appear to be irregularly shaped are actually normal rectangular pictures where some pixels are opaque and some are clear.

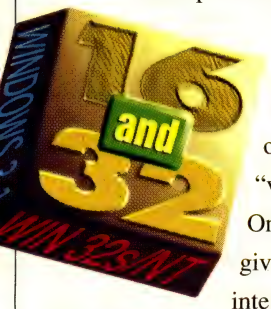
Only programs and file formats that can handle an active alpha channel will be able to use the transparency information. When you export to a standard format, the image is collapsed into a normal RGB picture.—*LS*



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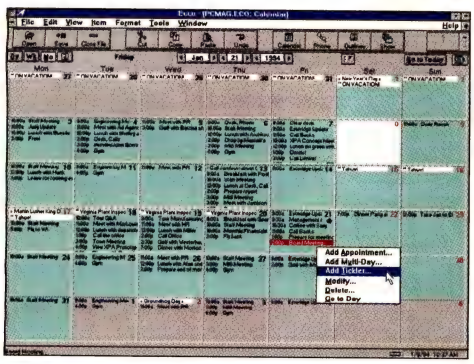
Personal Information Management

ECCO Simplicity Is Easier Than Pro Version

BY SCOT FINNIE

With a name like Simplicity, the new $149 "lite" version of Arabesque Software's ECCO Professional sounds like PIM perfection. While ECCO 1.0 drew rave reviews last summer as a versatile and robust personal information manager (First Looks, September 14, 1993), it didn't win much praise for ease of use. ECCO's outline-based underpinnings provide powerful cross-referencing and data portability, but the outline metaphor isn't familiar to most PIM users, and the program provides so many views that you're unlikely to feel comfortable with it right off.

Arabesque saw these drawbacks early on and responded with ECCO Professional 1.1 and ECCO Simplicity 1.1. The goal for Simplicity was to create a more accessible, more manageable PIM for people primarily interested in address book and personal scheduling tools.



FAMILIAR: *Get away from outlines with this instantly recognizable metaphor.*

The best of ECCO Simplicity's new usability features are its graphical weekly and monthly calendar views, which look like a Week-at-a-Glance date book and a wall calendar, respectively. Drag-and-drop and right mouse-button pop-ups are implemented extensively in these graphical views and throughout the program—a marked improvement.

To get new users up and running faster, Simplicity installs a simplified view that shows new larger toolbar icons with text labels. The toolbar has only three buttons: Calendar, Phone, and Outlines. There are five preconfigured outlines that ease the process of adapting to the outline metaphor.

Simplicity also provides five template views customized to different professions or tasks: Legal, Manager, Project, Research, and Sales. Additional tweaks include sorting from any view and new Preferences options for adjusting time slots in the calendar.

FEWER FEATURES

What Simplicity doesn't have is ECCO Pro's optional Advanced menu functions, which build user-created folders and columns. They let you group and view outlines of all types, customize grid columns, and create named filters for limiting the types of information shown in ECCO views. You can upgrade to ECCO Pro 1.1 for $199.

Simplicity is much easier to use than the professional version, but it isn't an all-new, greatly simplified PIM that blows away the competition for ease of use. Although it has been significantly dressed up, the powerful outline structure is still apparent in some parts of the program. But overall, Arabesque was successful in making Simplicity much less daunting to first-time users.

In addition to achieving its goal of being easier to use, Simplicity is an excellent value at its $79 introductory price. Meanwhile, the $395 ECCO Professional 1.1 is absolutely first-rate. That's because Simplicity's many usability enhancements come in the professional version, too.

• List price: *ECCO Simplicity, Version 1.1, $149 ($79 through December 1993).* Requires: *2MB RAM (4MB recommended), 3MB hard disk space, Windows 3.1. Arabesque Software Inc., 2340 130th Ave. NE, Bellevue, WA 98005; 800-457-4243, 206-885-4272; fax, 206-885-0127.*

Circle 420 on reader service card

Sound

Orchid SoundWave 32: Audio for Old and New

BY GREG PASTRICK

Today's sound boards face the challenge of integrating new standards and capabilities while offering quality coverage for existing features and formats.

Orchid Technology's SoundWave 32 board is a $299 solution to this problem. Its two Analog Devices processors give true 16-bit audio processing at a maximum sampling rate of 44.1 kHz for full CD sound quality. Meanwhile, its ROMs hold 8 megabytes of instrument and sound-effect samples that give you 24 simultaneous voices in Sound Blaster/Yamaha OPL2 or general MIDI mode and 32 in Roland MT-32 modes. The chip sets work in concert to support simultaneous processing of sound emulations in combination with its core Sound Blaster, Microsoft Sound System, and Roland MPU 401 MIDI modes and interfaces.

With digital sound processing based in its 20-MHz Analog Devices ADSP-2115 chip, the 16-bit board is designed with integrated interfaces for Sony and Mitsumi CD-ROM drives, too. It also has an external 15-pin joystick/MIDI port connection and a full array of line, speaker, microphone, and CD audio inputs/outputs. There are no external volume controls on either the board or its included unpowered speakers, but the SoundWave driver software and one of the board's bundled software packages gives you access to the board's audio settings.

In addition to its DSP, the SoundWave board has the Analog Devices 1848 CODEC, a version of the same chip used in Microsoft Sound System to handle analog-to-digital and digital-to-analog conversions with space-saving compression.

SOUND BITES

The SoundWave 32 samples MIDI, .WAV, and CD input at 8 and 16-bit file depths, while its rates range from 11 to 44.1 kHz. With the SoundWave DSP's Yamaha OPL 2 compatibility there's no direct support for advanced voice recognition capabilities built in, but the included Windows software packages all support Object Linking and Embedding (OLE), letting you transfer any sound file or composition to any other Windows application capable of receiving OLE data.

Street prices for the complete SoundWave 32 package, including microphone, speakers, and the software, should run about $230. Orchid also will be releasing a stripped-down version called GameWave 32, which will retail for $169 and have a street price of about $110.

• List price: *SoundWave 32, $299 (includes microphone and speakers).* Requires: *2MB RAM, DOS 3.3 or later, Microsoft Windows 3.1. Orchid Technology, 4535 Northport Loop West, Fremont, CA 94538; 800-767-2443; 510-683-0300; fax, 510-490-9312.*

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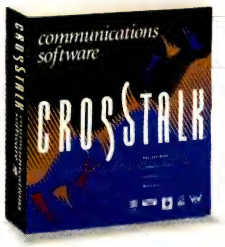
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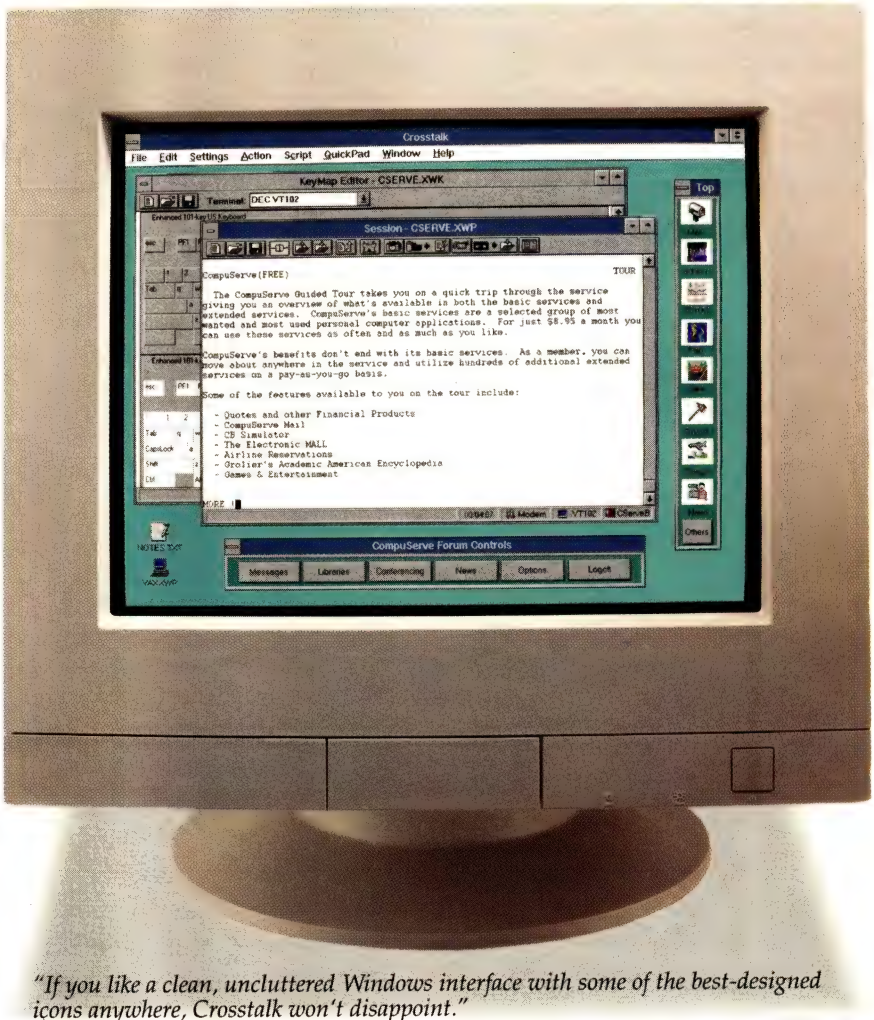
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■ Programming Languages

Symantec C++: Sudden, Serious Challenge to Borland, Microsoft

BY SHERYL CANTER

What do you get when you combine a Windows-hosted C++ compiler, an innovative new development environment, and a great suite of tools? The answer is Symantec C++.

Symantec C++ replaces Zortech C++ and incorporates the powerful MultiScope debugger; Optlink, SLR Systems' fast and efficient linker; Visual Programmer, a new visual designer and code generator from Blue Sky Software; and the MFC 2.0 (Microsoft Foundation Classes) application framework. The Professional Edition ($499) generates DOS, Win16, and Win32s programs; the Standard Edition ($129.95) generates only non-optimized, 16-bit programs.

While the weakest part of the Zortech compiler was its development environment, the development environment of Symantec C++ is arguably its greatest strength. It is unusually configurable and makes excellent use of drag-and-drop. If you've used the MultiScope debugger, the look and feel will be familiar to you since the new development environment is derived from it.

AN INNOVATIVE ENVIRONMENT

Symantec has coined a new acronym for its development environment—IDDE: Integrated Development and Debugging Environment. The environment is based upon "Views"—such as Source, Project, Function, and Class—which are accessed through a cluster of icons that can be moved or resized.

Rather than using a traditional multiple document interface (MDI), Symantec C++ places each View in its own, independent window, a technique reminiscent of Microsoft Visual Basic. A window's contents can be instantly changed by dropping a View icon onto it. If you drop the icon on an open area of desktop, a new window will open automatically.

The drag-and-drop interface is completely intuitive and extremely powerful. To view memory, you drag a variable from the Data View into the Memory View. To disassemble code, you drag a source code file from the Project View into the Assembler View. There are 16 views, and naturally they won't all fit at once onto your desktop. But you can save up to five desktop arrangements (called "Workspaces") and switch quickly between them.

The integrated editor is functional but primitive compared with the editors offered by the Borland and Microsoft C++ compilers. There is color syntax highlighting, but only four unchangeable colors are available.

FACT FILE

Symantec C++ Professional 6.0

Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234, 503-334-6054

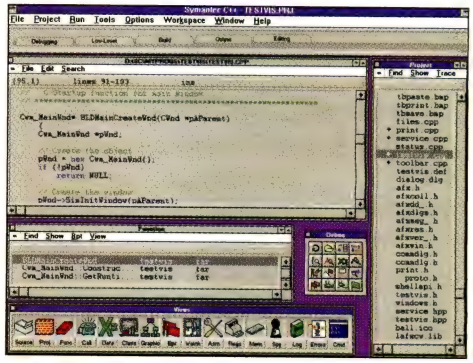
List price: $499. Upgrade from Zortech C++ or MultiScope, $149.95; competitive upgrade from Microsoft C++ or Borland C++, $199.95; Standard Edition, $129.95.

Requires: 4MB RAM (8MB recommended), 5MB to 55MB hard disk space, Windows 3.1.

In short: Symantec C++ boasts an innovative development environment, a stellar suite of programming tools, and the MFC 2.0 application framework.

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The Windows-hosted MultiScope debugger outshines both the Borland and Microsoft debuggers (see "The Art of Debugging," March 16, 1993). Its strongest feature, offered only in the Professional Edition, is its sophisticated postmortem debugging capability. You can take a snapshot of the system at the time of a program's demise and then view the information through normal debugging tools. MultiScope's only limitation is that it doesn't support 32-bit DOS programs. (A royalty-free DOS extender ships with the product.)



FREE FLOATING: *The environment has windows that contain various views of your program.*

SWEET SUITE OF TOOLS

Optlink, a popular replacement for the Microsoft and Borland linkers, has been licensed from SLR Systems and integrated into Symantec C++. Optlink is extremely fast and generates the smallest possible executables (see this issue's Toolkits column). Symantec C++ uses Version 4 of Optlink, which is one release behind SLR's current version.

The Visual Programmer, written for Symantec by Blue Sky Software, is Symantec's answer to the AppWizard and ClassWizard in Microsoft Visual C++. It succeeds partially. Though it can be launched from the Tools menu, it's a separate application and only loosely integrated with the IDDE. Also, while Visual Programmer is very good at generating interface code, it doesn't generate as much functional code as AppWizard. An MFC 2.0 code generator is included with the compiler.

The Professional Edition of Symantec C++ provides a graphical front-end to InterSolv's PVCS version control software. PVCS itself, however, is a separate purchase ($499 per user from InterSolv).

At the center of all these tools is Symantec's globally optimizing C/C++ compiler. All *x*86 command sets are supported, including the Pentium. Though there is no standalone assembler, an in-line assembler is provided. The C++ compiler is compliant with the AT&T Cfront 3.0 de facto standard and supports templates but not C++ exception handling.

A STUMBLING START

When Symantec C++ originally shipped in late September, it was missing the MFC code generator and suffered from quite a few bugs. The MFC code generator was shipped a few weeks later along with extensive patches to the IDDE and CVPACK. Replacements for the runtime libraries that fix numerous bugs and enhance compatibility with the Borland and Microsoft compilers are available on CompuServe or through tech support.

Symantec C++ has the potential for greatness in the world of C++ compilers. Historically a distant third in this highly competitive market, Symantec C++ offers a serious challenge to market leaders Borland and Microsoft. □

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CD-ROMS

Make Your Own CD-ROM Disks with $3,899 PlayWrite

BY MARK BROWNSTEIN

At $3,899, Microboards Inc. of America's PlayWrite CD-recordable system has the lowest price yet for a CD-R subsystem. With the PlayWrite, you create your own CD-ROM disks, filling them with nonchanging data such as catalog listings or archives, and then pass them to anyone who needs that data and has a CD-ROM drive with which to read them.

The PlayWrite package includes a CD-R drive manufactured by Ricoh, a power cord, a SCSI cable (you'll need a SCSI controller, preferably an Adaptec 1542), CD Record software from Dataware, and sketchy instructions on installation and setup.

Microboards recommends that you use at least a 33-MHz 486-based system with 4MB RAM with the PlayWrite. The system also requires enough available hard disk space to hold twice as much data as you want to put on the CD-R disk. In other words, if you want to record a 630MB CD-ROM, you'll need 1.2 gigabytes of available hard disk space.

SOFT CD

The software that comes with the drive lets you create a virtual disk image that can be copied to the recordable platter in the Ricoh drive. The recordable media sells for about $20 per individual disk.

To create a disk, you have two options: You can either copy an already-formatted ISO9660 file from an existing CD-ROM disk or you can copy a list of files to the recordable CD-ROM disk.

The software doesn't make it easy to copy whole directories or directory trees, although you may want to do this if, for example, you want to copy a Bernoulli disk's contents to a CD-ROM or if you want to back up an entire hard disk. In other words, you can use a $20 CD-ROM disk to store your data and then reuse your $100 Bernoulli or Syquest disk.

The drive, which records at 150 kilobits per second (half the speed of a more expensive Philips CD-R drive), can take more than an hour to record a full disk. Instructions are also included for recording audio; the PlayWrite can record audio CDs and CD-ROM XA disks.

Recording CD-R disks is not for the faint of heart. Installation is somewhat tricky, involving some manually entered configuration commands, and there's only 1 hour of free technical support. The user interface for the software is also shaky, although with a little practice (including a simulation mode that pretends a disk is being recorded) you should soon be turning out disks with little trouble.



CD WRITE: *PlayWrite records CD-ROMs.*

- List price: *PlayWrite, $3,899.* Requires: *33-MHz 386 system, SCSI controller, hard disk space equal to twice the amount of data you want to record. Microboards Inc. of America, 308 Broadway, P.O. Box 130, Carver, MN 55315; 800-225-4414; fax, 612-448-9806.*

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Window Utilities

Eclipse Find Delivers Fast, Cheap Text Retrieval

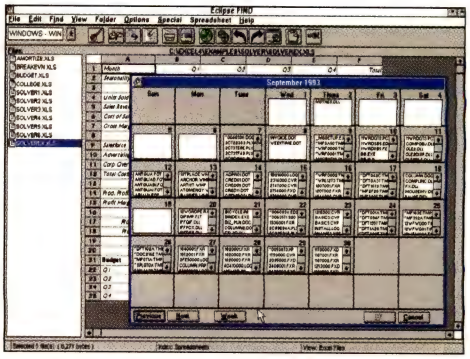
BY SCOT FINNIE

Half the productivity battle on most people's desktops is finding information that's already there. If you're willing to change the way you think about the process, Phoenix Technologies' $89 Eclipse Find file and text indexing and searching utility for Windows will give you an intelligent way to manage files.

The problem isn't just that it's difficult to recollect file contents from DOS' limited 11-character filenames. Even if you already know you want to delete 17 files in five directories that contain references to "Windows 3.0," there's no way in most utilities to act on them globally. Eclipse Find provides a way for you do this and a lot more. It catalogs, views, groups, searches, archives, and manages your files based on the words they contain. And it provides this broad utility through an efficient, up-to-date Windows interface.

If you're familiar with the discontinued Lotus Magellan for DOS, think of Eclipse Find as a sort of Windows successor to it. Eclipse Find aims squarely at text retrieval and file management for individual users. Its largest competition is likely to come from similar but less robust modules built into some Windows applications.

The cores of this utility are its indexing and text-search engines. Although not as fast as Zylab's $395 ZyIndex for Windows—the acknowledged speed demon of indexed text searches—Eclipse Find's search times are very respectable. It took just 17 seconds to complete a Boolean search of a 25MB index that was built for 1,355 data files. ZyIndex managed the task in 5 seconds.



SEARCH BY DATE: *Calendar view makes it easy to weed out older files.*

Phoenix has all the tools you need to get the job done: built-in PKZIP 2.04 file compression; incremental archiving and retrieval by indexed topic; viewers for word processing, spreadsheet, database, and graphics files; support for network drives; and full-fledged file-management tools.

What's *not* to like? Eclipse Find lacks proximity searches; indexes eat up disk space; and index creation also takes time. It took about three hours to build the index for the complex 25MB test index on a fast SCSI hard disk. But while Eclipse Find is building an index, you can multitask with other applications.

Eclipse Find performs its job admirably, making text retrieval a snap and adding a welcome new twist to file management.

- List price: *Eclipse Find, Version 1.0, $89.* Requires: *4MB RAM, 3MB hard disk space, Microsoft Windows 3.1. Phoenix Technologies Ltd., 846 University Ave., Norwood, MA 02062; 800-452-0120, 312-541-0260; fax, 312-541-0514.*

Circle 417 on reader service card

Communications

Hayes $99 ESP Serial Port: Smooth Data Transfers

BY EARLE ROBINSON

Completely redesigned and aggressively priced at $99, Hayes' new 16-bit ESP Communications Accelerator, Version 2.0, smart serial board improves performance of communications programs under DOS and Windows by off-loading the processing of data onto a coprocessor and providing large 1K I/O buffers.

The ESP board requires no fiddling with jumpers or DIP switches. The Windows setup program lets you select the COM port and choice of IRQs (including the high-order ones) that you want to use. Happily, it won't allow conflicts with reserved interrupts for the hard disk and other devices, though it ignored the presence of a PS/2 mouse on IRQ 12 and would have allowed the conflict if we'd selected it.

DOS SUPPORT

Unlike the first ESP board, the new version also supports DOS communication programs. Unfortunately, installation requires manually copying the DOS setup program to the hard disk.

Running the DOS configuration program enables support for ESP features, either in a DOS session within Windows or outside of Windows. You're instructed to do a full reboot, after powering off and on, for the settings to be implemeted. This is vital and applies to the installation within Windows, too, though you receive no warning in the Windows setup program.

System performance is much improved when using the ESP board. Foreground programs are unaffected by resource-intensive faxing or background data transfers. Most important, data overruns are completely eliminated due to a combination of the extended buffers of the 16550 UART on the ESP, the programmed I/O of the coprocessor, and large buffers: 1K each for input and output.

Using Microcom V.FC modems (28.8 Kbps) and ESP boards, we were able to achieve throughputs as high as 3,500 characters per second when transferring compressed files. Hayes claims somewhat higher rates when using compression, but current system limitations limited our maximum to 8,000 cps, and then only under very favorable conditions.

No support is available or presently planned for either OS/2 2.1 or Windows NT, and like other smart serial boards, the ESP board has no parallel port, which may make it less attractive for systems with few slots. The manual is also far from adequate. It provides neither good instructions, nor any technical details about the board. The good news is that Hayes says a new manual is in the works. A two-port version of the ESP Communications Accelerator will also be offered for $149.

The ESP 2.0 board handles resource-intensive data transmission with ease, avoiding data overruns and slowing of other system tasks. Its reasonable price and performance make it a great solution for faxing and high-speed data transfers.

• List price: *Hayes ESP Communications Accelerator, Version 2.0, $99. Hayes Microcomputer Products Inc., P.O. Box 105203, Atlanta, GA 30348; 800-964-2937, 404-441-1617; fax, 404-449-0087.*

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Presentation

PanelBook 450: Bright, Colorful Projection

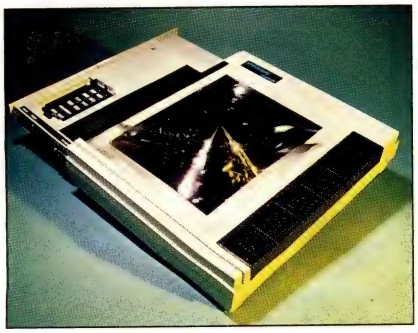
BY ALFRED POOR

When it comes to making presentations with your PC, LCD projection panels have a lot to offer. Unfortunately, you often have to pay top dollar to get a color panel that can produce a quality image, and your purchase may be a bit big to carry easily. Fortunately, In Focus Systems has addressed both of these problems with the new PanelBook 450.

This unit shares the same compact housing as the PanelBook 550; at 2 by 11.5 by 9.5 inches (HWD), either one will fit in a typical briefcase with room to spare, and their 6-pound weight won't give you gorilla arms.

The PanelBook 550 uses active-matrix LCD technology and comes with a $6,399 list price, competitive with other active-matrix panels. The PanelBook 450 is a much more affordable $3,299.

Why is the 450 so much cheaper? It uses TSTN^2 technology, In Focus Systems' enhanced version of triple super-twist nematic technology. Based on passive-matrix LCD technology, the display has a single liquid crystal layer sandwiched between two color-correcting plastic layers; there are three layers tuned for the three colors (cyan, magenta, and yellow). The result is a panel that offers better contrast and color saturation than other passive-matrix designs.



PANELBOOK 450: *Ready to project.*

COLOR FAST

In Focus Systems has also boosted the panel's performance, which results in faster pixel response times and a claimed 1.4-million-color palette. While the company rates the display as fast enough for animated presentations, such as Video for Windows clips, the panel was clearly not as fast as a CRT display in terms of showing a rapidly moving mouse pointer in Windows.

The PanelBook 450 was able to produce strong, saturated colors, but even the 1.4-million-color palette was not always able to reproduce a 256-color Windows image faithfully. The image quality was very good, however, with excellent brightness and contrast, and a cooling fan prevented any distortion due to panel heating.

The panel is easy to set up and adjust. A single double-headed cable connects the panel to your computer and monitor. The control panel functions are duplicated on an infrared remote control that you can use to adjust a wide range of settings, including contrast and image position. The on-screen menus make it easy to fine-tune the image quality.

Compared with active-matrix designs, this unit is bargain priced, yet the images are some of the best for passive-matrix color panels. If you need to take your show on the road, In Focus Systems' PanelBook 450 may be your best bet for a compact, cost-effective presentation panel.

• List price: *PanelBook 450, $3,299. In Focus Systems Inc., 7770 SW Mohawk St., Tualatin, OR 97062; 800-294-6400, 503-692-4968; fax, 503-692-4476.*

Circle 432 on reader service card



The secret HP, Compaq and Lexmark were hoping we wouldn't tell.

Take a close look at their page printers and you'll see: you spend your really big money on disposable printer cartridges.

One HP® LaserJet® 4Si, for example, in a high-volume* network printing environment could easily run up $4,183 in cartridge bills in its first year alone — more than the price of the printer itself. Five Compaq® Pagemarq™ 15s could cost you $22,193 in cartridges. And a year's worth of cartridges for ten Lexmark™ IBM® 4039 16L printers would probably set you back by about $41,611.

If you had no choice, these numbers would simply represent the cost of doing business. But the fact is, you do have a choice.

Cartridge-Free printing

Kyocera® is in the printer business, not the cartridge business. That's why we were free to develop Ecosys® Cartridge-Free printing. And why you can print up to 7,000 pages with an Ecosys printer with a single $49 no-mess Ecotone® toner refill.

In our high-volume network printing example, choosing an 18-ppm Ecosys FS-3500A over an HP LaserJet 4Si would save you $2,797 a year. Five FS-3500As would save you $15,263 compared with the Compaq solution, while ten FS-3500As would save $27,751 over Lexmark in just one year.

Best of all, you wouldn't give anything up. You'd get consistently high output quality, fast throughput, reliability and full network compatibility.

Cartridge-Free for consistent quality

The traditional laser printer uses disposable cartridges because the traditional drum built into them wears out fast. The Ecosys drum doesn't. Its durable amorphous silicon (a-Si) surface will last a fully-warranted three years/300,000 pages and beyond. Plus, Ecotone toner has ceramic particles to polish and recondition the drum with every page you print. The result for you is consistently clean output over the lifetime of the printer.

So what's the secret?

It's this: to evaluate a printing solution, you've got to consider cost of printing. And for networks with one to 1,000 printers, Ecosys Cartridge-Free printing is inherently more economical — by a wide margin.



How wide? The free Ecosys savings-at-a-glance calculator wheel will help you find out. For yours, or additional information on the Ecosys printer family, call **1-800-2-ECOSYS.**

Now that you know the secret, the only question is, how much can you save?

From the 10-ppm FS-1500A to the 18-ppm FS-3500A (shown alone and with full complement of paper handling options), Ecosys Cartridge-Free printers deliver world-class quality, performance and support with unprecedented economy.



KYOCERA

TECHNOLOGY WITH A CONSCIENCE.

All comparisons based on InfoCorp values: 5% average page coverage; "high-volume" = 16,500 pages/month. Retail prices (8/93)/InfoCorp yields used for calculations: HP 4Si cartridge—$169/8,000 pages; Compaq 15 cartridge—$269/12,000 pages; Lexmark 16L cartridge—$269/12,800 pages. To calculate: Cartridge price ÷ yield at 5% = cost-per-page; cost-per-page x total annual volume = annual cartridge expense.

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CIRCLE 370 ON READER SERVICE CARD



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To complete your computer ensemble, try on a high-tech, high-fashion ADI monitor.

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For color-coordinating your output, nothing compares with this line. It lets you digitally fine-tune the red, green and blue hues on your CRT for precise WYSIWYG color matches. And its 72-Hz scan rate gives you refreshingly flicker-free images. Plus it meets all major international EMI and ergonomic standards.

To make *your* fashion statement, call **(800) 228-0530** for an ADI dealer showroom location. Whatever size you need, be sure to ask about our special program on big and tall 15- and 17-inch models. For faxed product information and editorial review, dial **(800) 767-8182**.

March 16, 1993
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CIRCLE 226 ON READER SERVICE CARD

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NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Brad Grimes

NEW

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aere Corp.'s FAX and FIND software inks Caere's Personal PageKeeper 1.1 document management software and Delrina Corp.'s WinFax PRO 3.0. Now you can automatically receive, compress, index, and archive axes in PageKeeper databases, as well as fax documents directly from within PageKeeper. PageKeeper's Weighted Relevance Retrieval engine lets you quickly search the content of stored faxes using color codes and thumbnail images, while the Caere AnyFax optical character recognition (OCR) engine in WinFax PRO turns faxes into editable text.

List price: *FAX and FIND, $249. Caere Corp., 100 Cooper Ct., Los Gatos, CA 95030; 800-535-7226, 408-395-7000; fax, 408-354-2743.*

Circle 402 on reader service card

NEW

Digicom's New Multimedia Modem Is Software-Upgradable

Digicom Systems, the company that brought you modems that were upgradable through software, has a multimedia modem that's equally easy to upgrade and combines a 16-bit stereo sound card with a 14,000-bps data/fax/voice modem. Based on a digital signal processor from Analog Devices, Digicom's Sound Connection board holds modem algorithms in its memory, swapping algorithms from the hard disk in order to operate in different modes and at different speeds (depending on the application). When Digicom develops new, faster modem algorithms, you'll be able to download the faster "modem" from Digicom's electronic bulletin board.

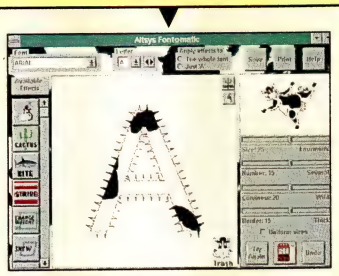
The Sound Connection is compatible with all major sound standards and includes SCSI and Sony/Mitsumi CD-ROM interfaces. It will soon be upgradable to wavetable synthesis capabilities by snapping a ROM chip into an open socket on the board.

• List price: *Sound Connection, $299.99. Digicom Systems Inc., 188 Topaz St., Milpitas, CA 95035; 408-262-1277; fax, 408-262-1390.*

Circle 408 on reader service card

Photography by Thom O'Connor

HOT PROSPECT



With Altsys' Font-o-matic Your Fonts Take a Wacky Bend

You've seen a lot of elaborate and ornate fonts recently, thanks in part to the TrueType technology in Microsoft Windows 3.1, but Altsys Corp., makers of the award-winning font editor Fontographer 3.5, has recognized your need to create your own wacky typefaces. That's why they've created Font-o-matic, a utility for adding special effects that are completely out of the ordinary to your TrueType or Type 1 PostScript fonts.

In the Font-o-matic editing window you can begin by enlarging, rotating, or skewing the fonts, and then add effects such as cow spots, cactus needles, Swiss cheese holes, and more. Font-o-matic uses slider controls for adding just the right effect. You work on a copy of the original font so that it stays intact, and when you're done, the new font is immediately available to all your Windows applications.

During editing, you choose a font such as Arial and begin work on a single character. By simply clicking on an icon, you can add the desired effect. After you've finished transforming the character, you can apply the effects to the entire font family or restrict them to the specific character, or undo all the effects and start over.

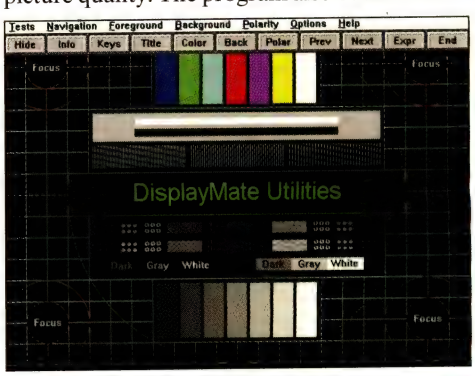
• List price: *Altsys Font-o-matic, $59.95. Altsys Corp., 269 W. Renner Pkwy., Richardson, TX 75080-9604; 800-477-2131, 214-680-2060; fax, 214-680-0537.*

Circle 401 on reader service card

NEW

Sonera Brings DisplayMate Video Utilities to Windows

Sonera Technologies, manufacturer of an extensive line of utilities for testing and optimizing display quality, has brought its expertise to the Windows environment with DisplayMate for Windows. DisplayMate works to improve sharpness and contrast, reduce geometric distortion, minimize Moire patterns, and enhance color and gray-scale accuracy. The program runs a series of test patterns across your Windows display, searching for problems with your monitor and suggesting ways to improve picture quality. The program also outlines what



DisplayMate's test patterns hone your image.

to look for in your display and details ways to adjust the monitor and video adapter. DisplayMate for Windows supports color modes from monochrome to 24-bit color.

• List price: *DisplayMate for Windows, $129 ($79 through March 31, 1994). Sonera Technologies, P.O. Box 565, Rumson, NJ 07760; 800-932-6323, 908-747-6886; fax, 908-747-4523.*

Circle 404 on reader service card

NEW

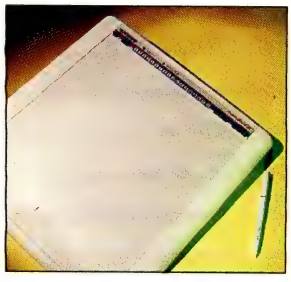
Philips Adds Digital Control of Internal Monitor Signals

Philips Consumer Electronics Co. has announced its new 21-inch, $3,499 Brilliance 2130 Computer-Controlled Monitor (CCM). It's an innovative design that extends digital technology to all the internal controls that affect a display's performance. The result is

superior image quality with advanced beam convergence and color and brightness uniformity. The Brilliance 2130 has 21 digitally controlled display modes, and achieves precise color matching through three color temperature modes. It supports refresh rates of up to 76 Hz at a resolution of 1,280-by-1,024, and has a .28-mm dot pitch. Philips includes an adapter that makes the Brilliance 2130 compatible with 14-, 17-, 19-, and 21-inch Apple resolution for use in mixed environments, and backs the unit with a three-year warranty on parts and labor.
• List price: *Brilliance 2130 CCM, $3,499. Philips Consumer Electronics Co., One Philips Dr., P.O. Box 14810, Knoxville, TN 37914-1810; 800-835-3506, 310-217-1300.*
Circle 405 on reader service card

IMPROVED

CalComp Goes Back to the Digitizer DrawingBoard



CalComp's newest digitizer, the DrawingBoard III.

CalComp continues to do what it does best—produce high-quality digitizing products. Its DrawingBoard III Model 3400 series of digitizing tablets includes six sizes, from 12 by 12 inches to 44 by 60 inches, that operate with both corded and cordless pointing devices. The new family, which replaces the DrawingBoard II line, is compatible with DOS, Windows, and Unix environments, and comes with CalComp's new pressure-sensitive pen stylus that lets you set the pen pressure sensitivity at one of 256 levels. If you'd rather use a mouse to navigate the DrawingBoard, CalComp offers 4- and 16-button models.

Each DrawingBoard III has an automatic installation and configuration program that helps you orient your tablet and make it work with various software programs. When running under Windows, the DrawingBoard III uses CalComp's Dynamic Windowing, which adds flexibility to the digitizer's screen-to-tablet mapping and makes it easy to switch between applications or to use the entire tablet. All DrawingBoard III digitizing tablets have a tablet surface menu with 18 blocks that can call up user-recordable macros when you tap them with the stylus.
• List price: *DrawingBoard III Model 3400 series, $495 to $3,145. CalComp Inc., 2411 N. LaPalma Ave., Anaheim, CA 92801; 800-932-1212, 714-821-2000; fax, 714-821-2832.*
Circle 407 on reader service card

BRIEFS

MODEMS

Best Data Products has unveiled a $259 multimedia modem, similar to Digicom's Sound Connection, called the ACE (Advanced Communication Enhancement) system. The modem uses IBM's Mwave digital signal processor. It combines a 14,400-bps data/9,600-bps fax modem with a 16-bit sound card. As a sound card, the ACE board features wavetable synthesis and a CD-ROM interface. It is software-upgradable and will eventually accompany V.Fast, color faxing, and video teleconferencing technologies as they are available. 800-632-2378, 818-773-9600.

Apex Data has announced an extensive line of Type II PCMCIA modems for use in the IBM ThinkPad 350 and 750 families of notebook computers. Modems for each ThinkPad family come in three models: a 2,400-bps data/ 9,600-bps fax modem, a 9,600-bps data/fax modem, and a 14,400-bps data/fax modem. Cards for the 350 family range in price from $239 to $555, while cards for the 750 family range from $289 to $379. 800-841-2739, 510-803-2020.

Calpak Corp. has released the MX-14414B internal modem ($199) with built-in bidirectional noise suppression. The 14,400-bps data/fax modem provides high-quality transmissions across all lines and under conditions such as lightning storms and power surges. The half-size board has four COM and four IRQ settings that are accessible from outside the PC, and the unit comes with easy-to-use, fully-functional fax software. 310-539-8366.

Modem giant **Hayes Microcomputer Products** is shipping the Optima 14400 FAX144 for PCMCIA modem ($399) for use in notebooks with Type II PCMCIA slots. It's capable of asynchronous and synchronous data communications using Hayes AutoSync. The modem comes with Smartcom for Windows and is covered under warranty for five years when you register the product with Hayes. 404-441-1617.

Intel Corp. has introduced the Intel Faxmodems for PCMCIA ($249 to $399), a series of three Type II PCMCIA mo-

NEW

Newest Software from BitFax Supports Voice and Data

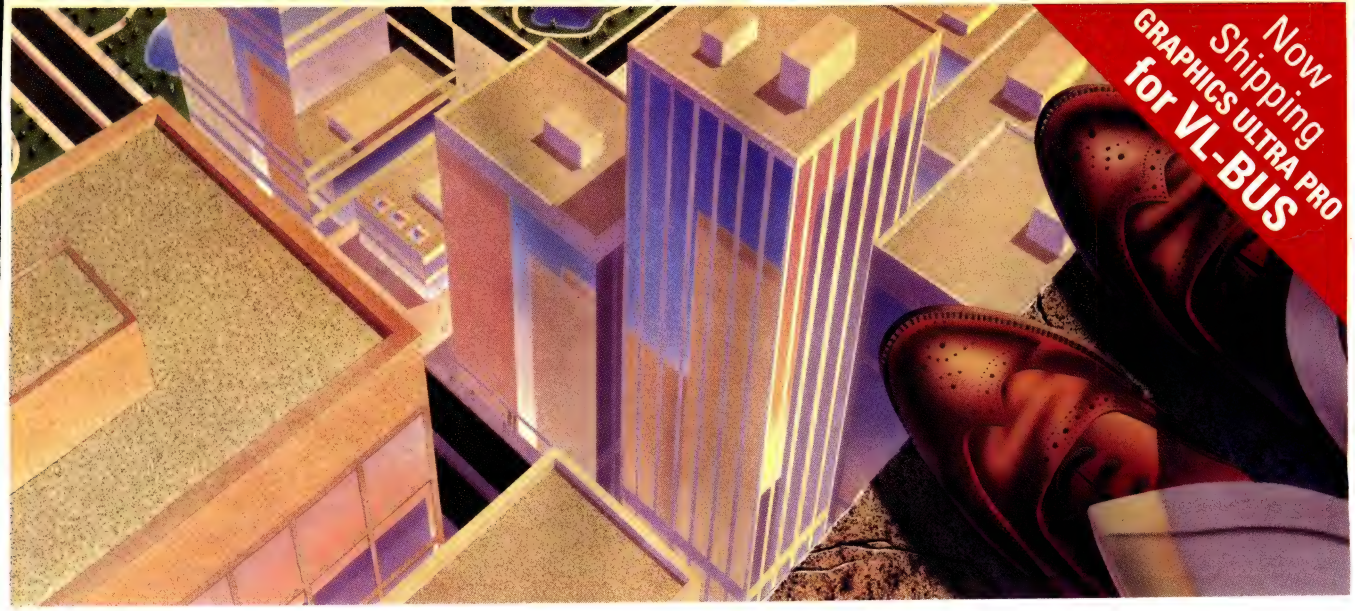
The SharePort technology in **Bit Software**'s new BitFax Professional automatically distinguishes among incoming data, fax, and voice calls. BitFax Professional's Voice Manager receives, logs, records, plays, and stores personal voice messages in conjunction with all voice modems that use the Rockwell or Sierra voice chips by clicking on buttons that resemble those on an answering machine. Through Voice Manager's interface you can easily set up multiple voice mailboxes, each with its own greeting and distinct password. There's even an Auto Pager option that automatically calls a user's pager when they receive a voice message or fax.

The fax engine supports drag-and-drop for quickly transmitting, viewing, and printing faxes, and uses Caere's AnyFAX OCR for converting faxes to text. The software also has tools for annotating faxes, and supports Twain-compliant scanners. A fax management module lets you create and assign folders to groups of faxes.
• List price: *BitFax Professional, $129. Bit Software Inc., 47987 Fremont Blvd., Fremont, CA 94538; 510-490-2928; fax, 510-490-9490.*
Circle 406 on reader service card

NEW

PDA Stores Contacts Using Voice Recognition

Voice Powered Technology's first product lets you program your VCR using just your voice. Voice Organizer is essentially a personal digital assistant that's also voice-driven. By speaking into the hand-held device, you can store up to 99 appointment memos, and 400 phone numbers for 100 contacts. To input a memo, you press the Record button and leave a description, then press the Time button and say the time, day, and date. The Voice Organizer will beep at the time of the appointment and let you play the recorded description. To input contacts, you press the Phone button, say the name twice and say the phone number, then press Save. To retrieve the number, you simply say the contact's name. The unit runs on five rechargeable nickel cadmium batteries that should last seven days.
• List price: *Voice Organizer, $199.95. Voice Powered Technology Inc., 19725 Sherman Way, Canoga Park, CA 91306; 800-743-2000, 818-407-5600; fax, 818-407-5651.*
Circle 403 on reader service card



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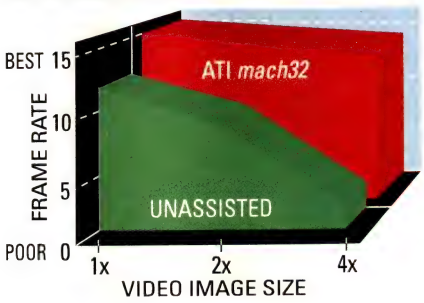
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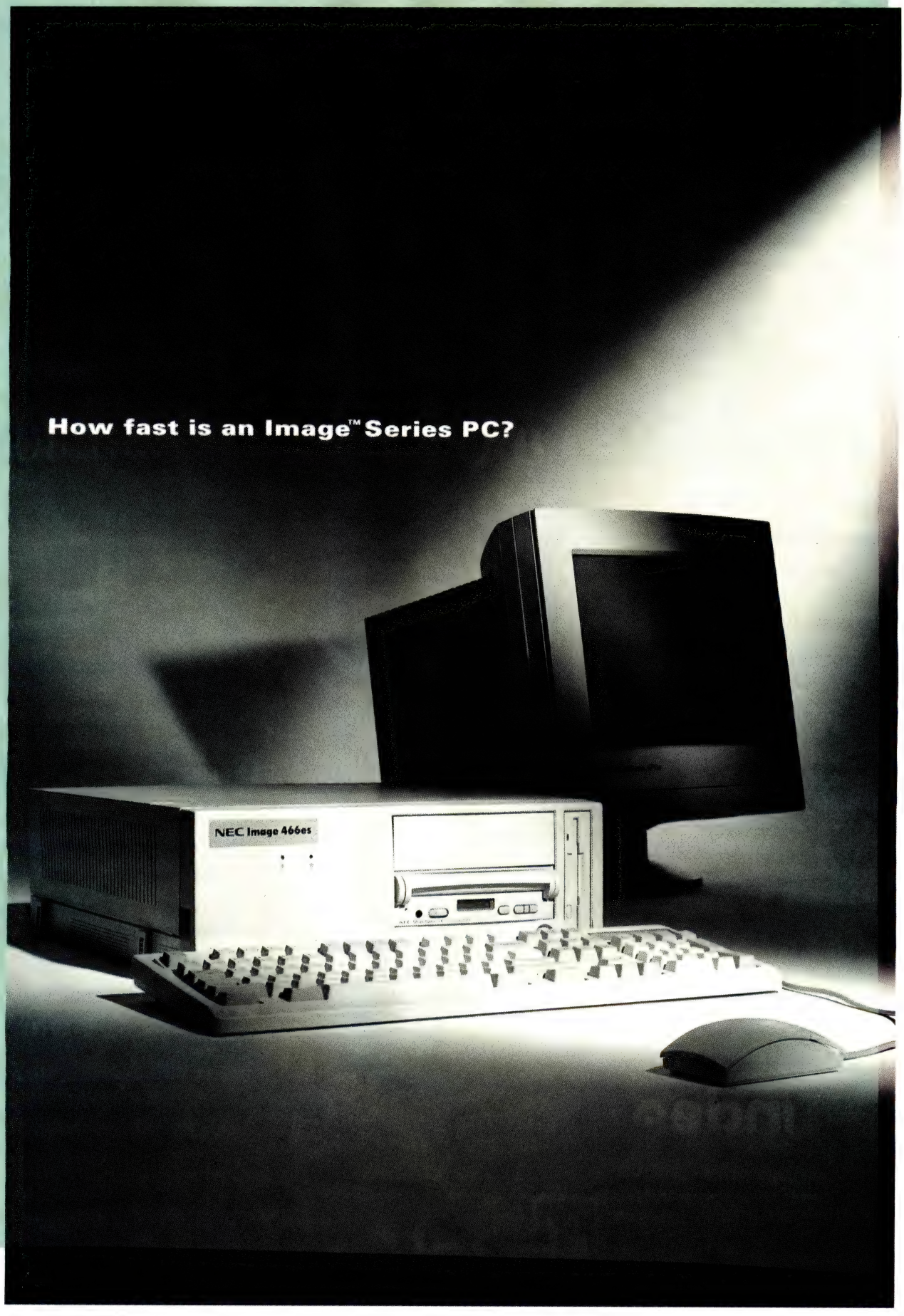
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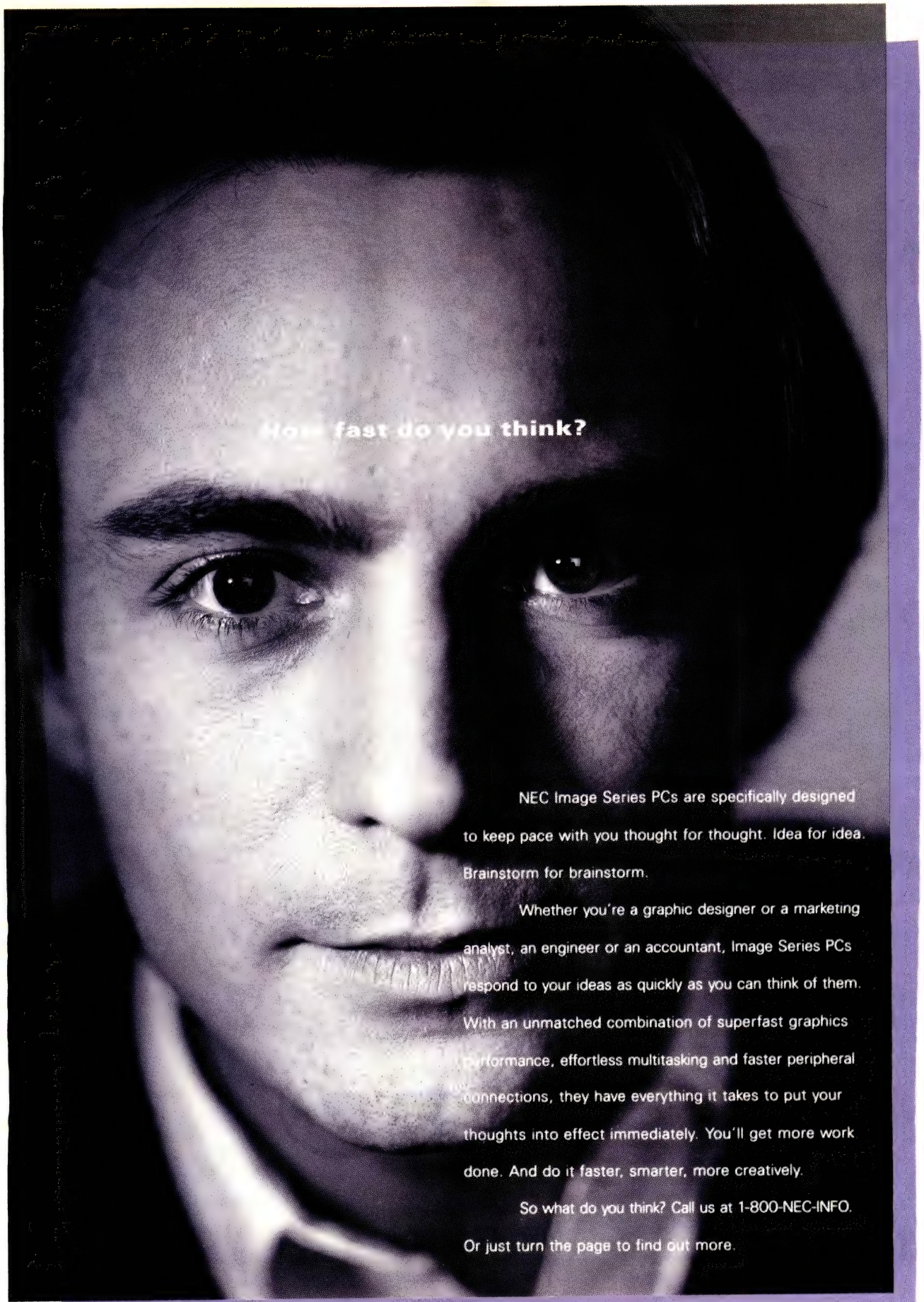
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Some more information to bring you up to speed.

The Image 466es for advanced business and graphics applications.

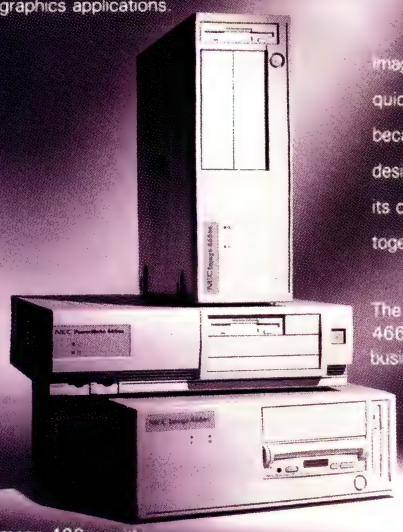
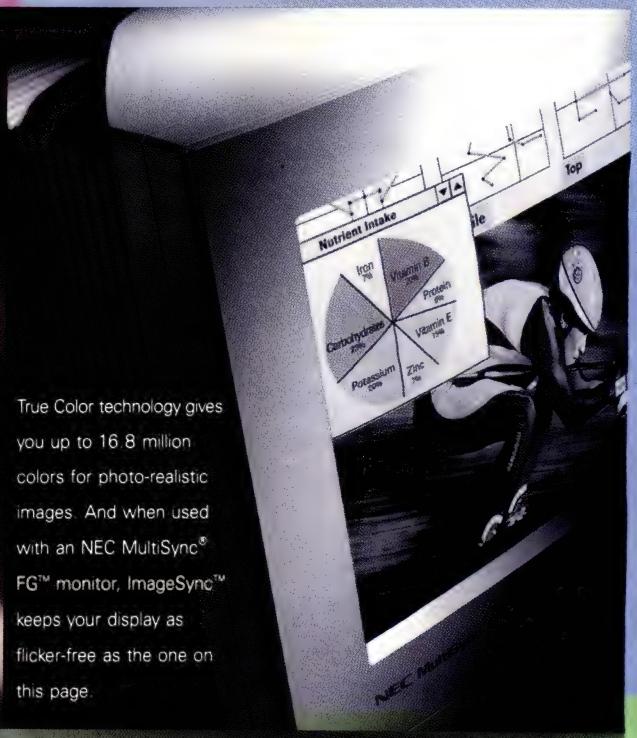


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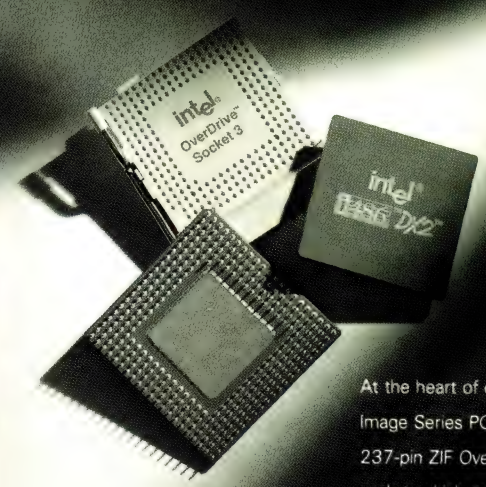
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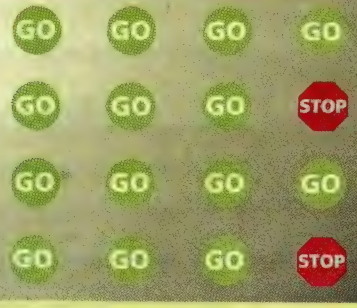
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NEC

CIRCLE 044 ON READER SERVICE CARD

NEW

Weitek Prepares to Top Its Own Video Accelerators

Get ready for video cards that use **Weitek Corp.**'s newest generation graphics accelerator. The popular Power 9000, which garnered Weitek finalist honors in *PC Magazine*'s Awards for Technical Excellence this year, provided a sound foundation for the new Power 9100 chip. The P9100 operates at 50 MHz rather than 33 MHz, addresses 4MB of VRAM rather than 2MB, and provides 24-bit hardware acceleration rather than 8-bit.

For improving the performance and image quality of any Microsoft Video for Windows application, Weitek is also introducing the new Video Power chip, which takes over most of the video computing functions previously performed by the system's CPU. It lets video applications run full-screen at 30 frames per second, at resolutions up to 1,280-by-1,024.

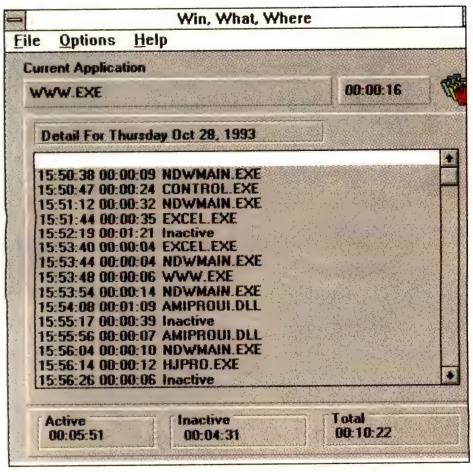
• List price: *Weitek Power 9100, $85 in quantity; Weitek Video Power, $30 in quantity. Weitek Corp., 1060 E. Arques, Sunnyvale, CA 94086; 408-738-8400; fax, 408-739-4374.*

Circle 409 on reader service card

NEW

Software Utility Keeps Track Of What You Do in Windows

You may not care to keep track of what tasks you're performing in Windows and for how long, but **Basic Systems** has introduced a software utility that does just that, and its applications are very real. Win, What, Where works in the background and tracks every activity that takes place in Windows, including when the task began, how long it lasted, and what files were involved. The information comes in handy when you're tracking work time for billing and tax purposes, or to provide a detailed sequence of events before a system failure so you can troubleshoot the problem.



Win, What, Where logs an entry into its screen every time you run a program.

You can view the activity listings in summary or detailed formats and group days to generate reports. Win, What, Where will automatically delete a history after a user-defined period of time, and it will also summarize information by the number of times a program was run and the total time spent in the program.

• List price: *Win, What, Where, $37. Basic Systems Inc., 2103 W. Canal Dr., Kennewick, WA 99336; 800-242-4775, 509-735-2386; fax, 509-735-1730.*

Circle 410 on reader service card

BRIEFS

MODEMS

dems that include 2,400-bps data/9,600-bps fax, 9,600-bps data/fax, and 14,400-bps data/fax models. The modems can be hot-swapped under both DOS and Windows, and they feature sleep and resume modes to conserve battery power. All three come with Intel FAXability Plus and Hilgraeve HyperAccess Lite software. 800-538-3373, 503-645-6275.

SOFTWARE

Stairway Software is shipping version 3.0 of ScreenExtender ($99.95), its popular utility that increases the amount of screen space you can use in WordPerfect for DOS. ScreenExtender 3.0 works with WordPerfect 6.0, and lets you choose from up to 25 screen sizes. You can display up to 144 characters per line. It has new font technology so you can see all the WordPerfect character sets as you edit. Laptop users have a choice of six display fonts that are changed through a pop-up window. 800-782-4792, 804-437-7000.

Magee Enterprises has announced a version of its Automenu DOS menu utility that is aimed specifically at children. Automenu For Kids ($29.95) provides a visual backdrop for accessing games and learning software. Children point and click from iconic menus with either a spaceship cockpit, video arcade, or city street background. The program also has a locking feature that prevents youngsters from accessing certain files. 800-662-4330, 404-446-6611.

Second Nature Software has unveiled 30 screen-saver and wallpaper collections, priced at $15 apiece (or three sets for $30) with 10 per cent of the proceeds going to benefit a variety of nonprofit organizations. Collection titles include Claude Monet and Pierre Auguste Renoir, as well as Cats by Siri, Art Wolfe's Animal Kingdom, and David Muench's National Parks. Each collection comes with Second Nature's Slide Show, a wallpaper sequencer, and a screen-saver control program. It's After Dark-compatible and displays Microsoft Scenes collections. 800-782-7000, 503-291-9500.

NEW

Xing Tech Unveils Real-Time MPEG Video Encoder Board

Xing Technology's new XingIt! video compression board sets a new standard for affordable MPEG-compliant, real-time encoders. It captures, filters, and compresses NTSC, PAL, and SECAM video signals, and then it displays compressed video in a 320 by 240 pixel display at 30 frames per second without needing special hardware—the real-time playback uses only software.

The XingIt! ISA board uses Philips Semiconductor digital video integrated circuit technology for capture, scaling, and filtering. Xing's MPEG encoder algorithms reside on an Analog Devices digital signal processor operating at 16 Hz. It works with Microsoft Video for Windows and all Windows-compatible sound cards.

• List price: *XingIt!, $499. Xing Technology Corp., 1540 W. Branch St., Arroyo Grande, CA 93420; 800-294-6448, 805-473-0145; fax, 805-473-0147.*

Circle 411 on reader service card

NEW

Samsung Fills Out Two Families Of High-End Printers

Samsung Electronics America's Finale 8000 laser printer was lonely until the vendor introduced a complete line of page printers and laser printers to keep it company. The Protege 5000 and Protege 5050 are 5-page-per-minute page printers that output text and graphics at 300 dots per inch, while the Protege 5600 is a 5-ppm laser printer that operates at 600 dots per inch. On the higher end are the

Finale 1012, a 10-ppm, 1,200-dpi laser printer, and the Finale HighRes, an 8-ppm, 1,200-dpi laser printer that uses Samsung's High Resolution Halftone Technology. The Protege and Finale printers are powered by RISC processors for enhanced performance.

• List price: Protege 5000, $1,295; *Protege 5050, $599; Protege 5600, $799; Finale 1012, $2,495; Finale HighRes, $2,086. Samsung Electronics America Inc., 105 Challenger Blvd., Ridgefield Park, NJ 07660-0511; 800-933-4110, 201-229-4066; fax, 201-229-4069.*

Circle 412 on reader service card

NEW

Ricoh Combines Fax Machine, Copier, and Ink Jet Printer

First, Soho was a London neighborhood. Then it was a funky downtown section of New York City. Now it's a PC market segment of small office/home office users that companies like **Ricoh Corp.** are trying to reach. Ricoh's new Ricoh FAX800 is a combination copier, fax machine, and ink jet printer that attaches to your parallel port and manages all your home office tasks. As a fax machine, the FAX800 uses Smart Memory to store 29 pages of incoming faxes until the printer is free. As an ink jet printer it outputs text and graphics at up to 360 dots per inch and emulates Canon BJ-10e, Epson LQ-510, and IBM ProPrinter printers.

In addition, the Ricoh FAX800 accepts up to 10 pages at a time through its automatic document feeder for making copies, and has a switch for distinguishing between incoming faxes and phone calls.

Voice calls can be automatically routed to an answering machine through a special interface, and a on-hook dialing features lets you dial without lifting the phone. If you'd like a handset, one is available as an option.

• List price: *Ricoh FAX800, $1,845. Ricoh Corp., 5 Dedrick Pl., West Caldwell, NJ 07006; 800-637-4264, 201-882-2000; fax, 201-882-2506.*

Circle 413 on reader service card

NEW & IMPROVED

Corel Bears the First Fruit of Ventura Acquisition

In September, **Corel Corp.** completed a buyout of Ventura Software and got Ventura Publisher and Ventura Database Publisher in the process. Now they're releasing Corel Ventura Version 4.2, a combination of the two Ventura products with extensive font, photo, and clip-art libraries, at a list price of $249. A collection of over 100 photos come on CD-ROM.

Corel Ventura includes support for Adobe Acrobat, so you can create elaborate electronic documents and generate bookmarks and hypertext links. The product also comes with Ventura Separator for color prepress operations and Ventura Scan for scanner support.

Registered users of Ventura Publisher can upgrade to Corel's rendition of the desktop publishing package for $99, while registered users of any CorelDRAW version can buy Corel Ventura 4.2 at the same price.• List price: *Corel Ventura 4.2, $249. Corel Corp., The Corel Building, 1600 Carling Ave., Ottawa, Ontario, Canada K1Z 8R7; 800-836-3729, 613-728-8200; fax, 613-761-9176.*

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BRIEFS

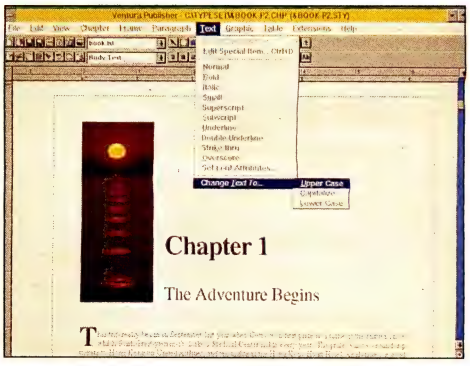
SOFTWARE

Borys Inc. has introduced a six-in-one calculator program for Windows called MasterCalc ($49). MasterCalc includes Mini, Math, Business, Statistical, Unit, and Programmer's calculators, each of which can be customized to accept data in various formats. The Unit calculator performs basic unit conversions and lets you do calculations on physical entities. The Programmer's calculator includes Boolean operations and lets you perform bitwise functions. 708-837-9680.

Intex's Forecast! spreadsheet add-in is now available for Lotus 1-2-3 for Windows, Release 4.0 ($165). Now Forecast! has full mouse support, pull-down menus, and dialog boxes for making it easier to perform forecasts in 1-2-3 for Windows. A more flexible tool for loading data lets you bring data into Forecast! manually, from named ranges, or directly from the Windows Clipboard. By clicking on a "load" dialog box, you can specify the format in which data should be loaded. 617-449-6222.

Automap is shipping Destination Europe ($49.95), an add-in to its Automap Road Atlas. The Destination Europe package lists more than 8,400 cities and 250,000 motorways, autobahns, and autoroutes across Europe in order to help you plan excursions to the continent. Addresses and phone numbers for hotels in major cities are provided, as well as seasonal weather information. Destination Europe requires either the DOS or Windows version of Automap Road Atlas 3.0. 800-440-6277.

Kansmen Corp. has entered the crowded market of Windows desktop managers with Cool-Cool-Can ($59). The program assigns icons to your Windows groups and lines them up along the bottom of the screen. When you click on one, the applications in that group are displayed in the main window. Cool-Cool-Can includes support for ZIP files, drag-and-drop capabilities, and graphical file viewers. You can program Cool-Cool-Can so that a single click of the right mouse button accesses programs. 408-263-9881.



Corel's Ventura combination makes for an interesting "new" entry into desktop publishing.

NEW

Portable Magneto Optical Drive Has Parallel and SCSI Ports

Analog & Digital Peripherals (ADPI) produces a line of portable backup devices called One For All that features both parallel and SCSI ports so you can back up data from a variety of computer platforms. The latest is the One For All Model RO128 3.5-inch portable 128MB rewritable optical drive. The ISO standard drive operates at transfer speeds of up to 4MB per second over SCSI 2 ports, and at seek times of up to 28 milliseconds. The 5.5-pound unit has a handle of its own, and comes with one primary backup software program, all the necessary cables, and one rewritable optical disk. ADPI will have a 230MB version of its portable optical drive out soon, at a price of approximately $1,995.

• List price: *One For All Model RO128, $1.495. Analog & Digital Peripherals Inc., P.O. Box 499, Troy, OH 45373; 800-758-1041, 513-339-2241; fax, 513-339-0070.*

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Unpar Tas

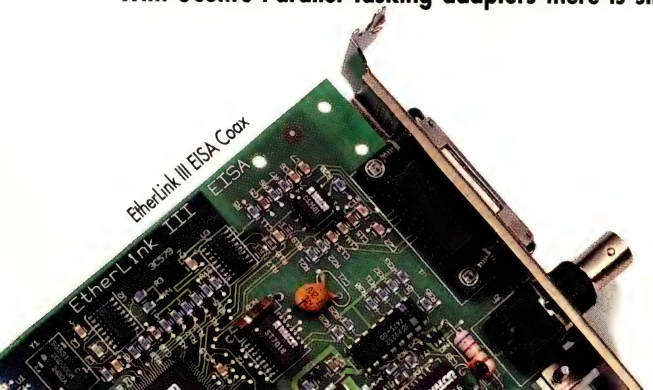
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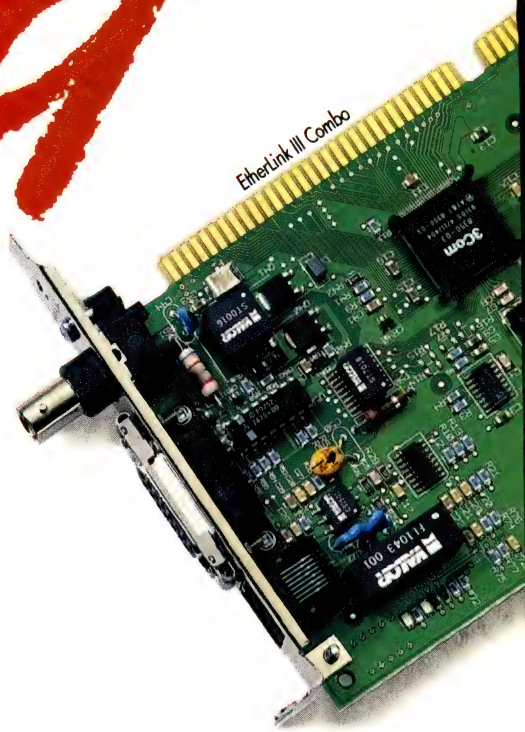
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"...the only extra the Matrox engineers left out was a seat belt."
James Karney
PC Magazine, Sept. 14, '93

Full of features. MGA-II gives you the most advanced Windows and CAD productivity features. Using MGA's Control Panel, you can easily access hardware pan and zoom; a virtual desktop of 1600 x 1200; on-the-fly resolution switching without rebooting Windows; and a color dithering process that simulates 24-bit color in 8-bit modes up to 1600 x 1200 . And for CAD users, MGA comes bundled with Matrox DynaView™, a powerful interface for AutoCAD and MicroStation creating the smoothest real-time pan and zoom.

"(MGA) ... includes more advanced Windows features than I've seen on any other graphics board."
Evan Yares
CADalyst, July '93

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"The MGA...offers superior performance, first-class drivers and unbelievable value for money."
Martin Gordon
PC User (UK), Late Aug. 93

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Peter Coffee
PC Week Magazine, June 14, '93

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*Estimated WinMark scores based on in-house testing of MGA-I using Ziff-Davis WinBench 3.11, Pentium 66 MHz, 64Mb RAM, 512K cache, 1024 x 768 in 256 colors, 72Hz.

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Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Lance Ulanoff

Literature for Developing FoxPro Cunning

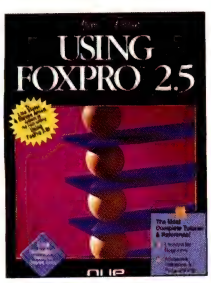
BY SHERYL CANTER

As database products go, FoxPro is one of the best. A *PC Magazine* Editor's Choice, FoxPro combines a rich set of interactive tools that require no programming with a powerful suite of development tools for writing custom database applications.

Just as the feature set of FoxPro runs the gamut from elementary data access to sophisticated custom development, so does the spate of new books on FoxPro, Version 2.5—the first release since Microsoft acquired the product in mid-1992.

With Version 2.5, there is finally a Windows version. So most of the new FoxPro books come in both DOS and Windows editions.

WINDOWS FIRST



For beginners, there's *Running FoxPro for Windows* or *Running FoxPro for MS-DOS*, both by Sal Ricciardi, a contributing editor to *PC Magazine*. Well-organized and clearly written, *Running FoxPro* takes you through the basics of what a database is and what constitutes good database design. FoxPro's interactive features are explained in thorough detail—with the notable exception of the development tools. Though the Screen Builder, Menu Builder, and Project Manager do not necessarily require programming, custom database design was deemed beyond the scope of the book.

Running FoxPro does an excellent job of explaining basic FoxPro concepts and offers clear explanations on how to normalize data and set up one-to-many relationships between tables. While feature coverage is not comprehensive, the selection of which commands to discuss is intelligent, and the reader comes away with a solid working knowledge of how to get things done.

With its step-by-step tutorial style beginners will find *Running FoxPro* patient and kind. However, experienced FoxPro users will find little that's new, and if you want guidance in using the development tools, you'll need to consult another reference.

IN THE MIDDLE

Perhaps the most comprehensive book on FoxPro is *Using FoxPro 2.5*, Special Edition, by Lisa Slater and Steven Arnott. This book covers the DOS version of the product; for Windows, there is *Using FoxPro 2.5 for Windows*, Special Edition, by the same authors. *Using FoxPro 2.5* runs well over 1,000 pages, and is packed with everything from database fundamentals to advanced programming tips.

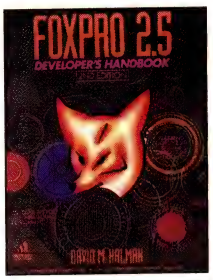
The book takes a tutorial approach, relying heavily on extended examples that are used to illustrate everything from basic concepts to advanced techniques. But this approach works best when reading from cover-to-cover—not very realistic for a book of this size—and the format makes it awkward to use as a reference. Thanks to its comprehensive index, you can unearth all the mentions of a particular topic, but when you turn to the page you'll often find yourself in the middle of a long example, making the discussion difficult to follow.

The tutorial approach also contributes to the book's rather haphazard organization. For example, information on creating a one-to-many relationship between tables, locatable only through the index, is buried within an example on how to use the browse window. Even the chapter ordering seems somewhat random. The first chapter guides the reader through a whirlwind tour of FoxPro that will leave many beginners mightily confused. The description of what a database actually is doesn't come until Chapter 3.

Despite its shortcomings, *Using FoxPro 2.5* contains some nice touches. An appendix provides a complete guide to FoxPro's default file extensions—something rarely found in the FoxPro manuals. And if you take the time to read each section carefully, you'll find some excellent tips for power users, along with solid advice on program style.

A DEVELOPER'S TREASURE

For the truly advanced FoxPro user, there is *FoxPro 2.5 Developer's Handbook* by David M. Kalman, the editor-in-chief of *DBMS Magazine*. The book covers both the DOS and Windows versions of the product. If you want to know how FoxPro really works, read this book. From its savvy synopsis of the history of FoxPro to its detailed discussion of the FoxPro API, *FoxPro 2.5 Developer's Handbook* gives the reader an inside view of what makes FoxPro tick, and how best to exploit it.



The introduction includes a lucid description of the FoxPro architecture. Later chapters detail the inner workings of FoxPro's memo fields, indexes, the browse window, Rushmore technology, and other key topics for developers. Hints and warnings throughout the text alert you to FoxPro anomalies and unexpected behavior. Serious FoxPro developers will want this book.

- **Running FoxPro for Windows**, by Sal Ricciardi, $24.95; Microsoft Press, 800-227-4679; ISBN: 1-55615-553-0. **Running FoxPro for MS-DOS** ISBN: 1-55615-556-5.
  Circle 485 on reader service card
- **Using FoxPro 2.5 for Windows**, Special Edition, by Lisa Slater and Steven Arnott, $35; Que, 800-428-5331; ISBN: 1-56529-002-X. **Using FoxPro 2.5**, Special Edition; ISBN: 1-56529-065-8.
  Circle 486 on reader service card
- **FoxPro 2.5 Developer's Handbook**, 2nd Edition, by David M. Kalman; $30.00; Random House Electronic Publishing, 800-733-3000; ISBN: 0-679-79159-0.
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Read Only Recommends



Tinkerers should enjoy this one. *Build Your Own Low-Cost PostScript Printer and Save a Bundle*, by Horace W. LaBadie, Jr., $19.95, Windcrest/McGraw-Hill, 1-800-233-1128, ISBN: 0-8306-4306-0.

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The HP DeskJet 310 costs only $379,* yet it comes loaded with 84 typeface, size and style combinations, along with a new lightweight, multi-voltage power adapter. It prints portrait and landscape on plain paper, transparencies or labels, and it uses HP's own inkjet technology for clear, crisp output at up to three pages per minute.

If that's not enough for you, a whole family of optional accessories is available, including a color kit for just $49, and a multi-page sheet feeder for easier desktop printing.

HP has managed to fit everything you could want into a little printer package. To see for yourself, look in the Yellow Pages, or call 1-800-552-8500, Ext. 7858 for the name of the HP dealer nearest you.†

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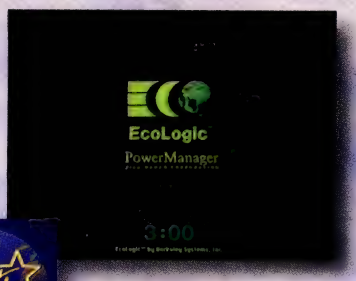
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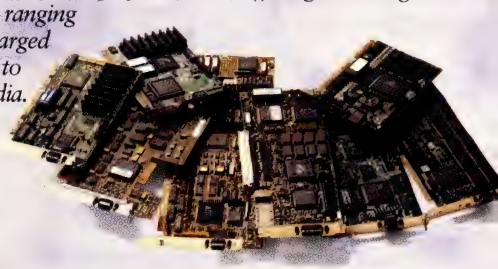
Our new line of Ecological Design™ Monitors incorporates advanced energy-saving features including PowerManager, which cuts power as much as 93% when the monitor is not in use. (After Dark screen saver software free with each monitor.)



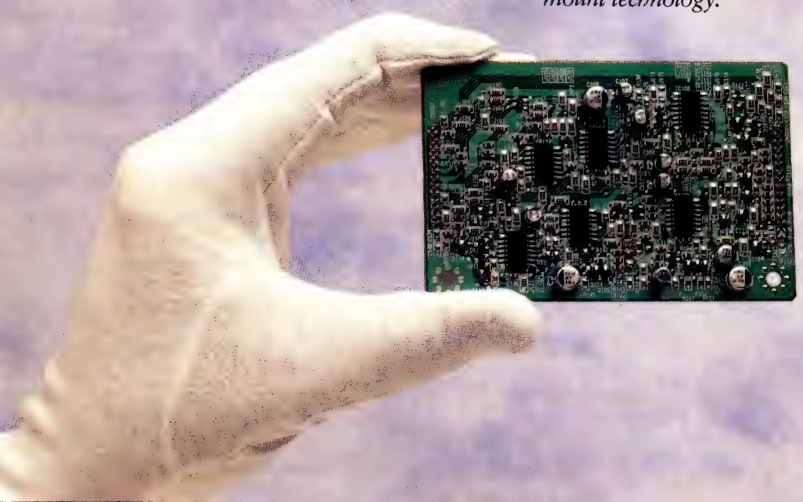
Nanao was the first monitor company to join in partnership with the EPA Energy Star Program. Our commitment to bring technical innovation to today's environment ranges from eliminating CFCs in our manufacturing process to using recyclable packaging and paper products.

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High quality PCB boards are assembled, adjusted and inspected at Nanao's special chip-mounting factory. All PCB boards are built using sophisticated surface-mount technology.



Model	Size	Dot Pitch	Scan Frequency	Recommended Resolution
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T560*i*	17"	0.25mm	H:30-82kHz V:55-90Hz	1280x1024
F760*i*-W	21"	0.31mm	H:30-78kHz V:55-90Hz	1280x1024
F560*i*-W	17"	0.26mm	H:30-82kHz V:55-90Hz	1280x1024
F550*i*-W	17"	0.28mm	H:27-65kHz V:55-90Hz	1024x768
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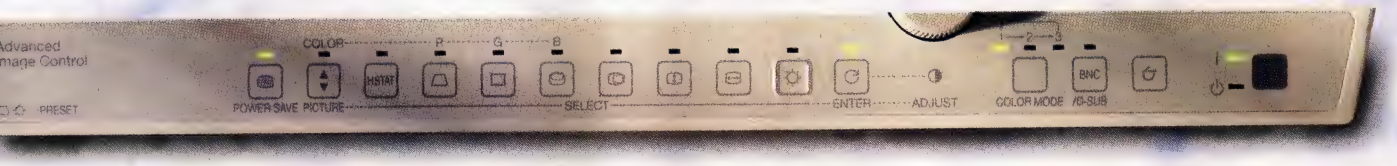


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Michael J. Miller

PC Magazine Goes CD

People are talking about the coming of "interactive media." At *PC Magazine,* we decided that rather than just talking about it, we wanted to try it. As a result, we have just completed our first *PC Magazine CD,* a CD-ROM companion to the magazine, containing the 486 Buyers' Guide from our December 7, 1993, issue along with many other features.

It's been a fascinating project because it has shown us the strengths and possibilities of this new medium and has revealed some of its limitations.

TOMORROW'S TOOL

Let's start with the strengths. The new technology lets us do many things we could never do in the printed version of the magazine. For instance, we can include our benchmark tests. They let you test your own system and compare it with any of the machines or video boards we reviewed in the December 7, 1993, issue. Thanks to our friends at Computer Library, we are also able to include full text for all articles that appeared in *PC Magazine* between October 1992 and November 1993 in an interactive, searchable format.

We can also include the test files that our lab technicians and reviewers actually created in PC Magazine Labs using today's multimedia presentation tools. These test files—along with final reviews from the magazine—give readers a real feel for what these multimedia packages can do. After all, seeing is believing.

All this shows the potential of CD-ROM as an interactive medium. Nevertheless, it's still just an experiment. We don't know—and neither does anyone else—exactly what readers want from an "electronic magazine." The most important thing we hope to gain from this first CD-ROM is an indication of whether readers want this kind of information and how they will use it. (The disk is available for $14.95 plus $3.00 shipping and handling; call 1-800-787-9677.)

The process of creating a magazine on CD-ROM presents a whole new series of technological questions—quite separate from those encountered during the regular publication of *PC Magazine.* An electronic magazine requires a different design than a printed magazine needs, in part because it should be interactive and in part because a screen looks so much different from a printed page. Today's screens do not have nearly the resolution of a printed magazine page and usually do not offer comparable depth of color, either. So we can't have the same kind or amount of art. And most people don't have the selection of fonts we have for printed output, so we have to use a font set that represents the least common denominator.

Perhaps a more fundamental question is what magazine articles should look like in an interactive format. In other words, what is the best user interface? It turns out that there may not be *one* best, and we ended up with several different UIs in different parts of the CD.

Computer Library also supplied us with Computer Select's new Windows-based search engine to use with the text. A while back, we started packaging and offering a series of questions and answers from our Solutions section on ZiffNet, our on-line system. For that we used the standard Windows help system, and it worked so well we decided to include it in *PC Magazine CD.* But for the main stories on the CD-ROM, we used a completely new point-and-click user interface, which looks more like a standard magazine format. This was developed by our colleagues at Ziff Desktop Information (ZDI).

All three user interfaces have their strengths and weaknesses. Computer Select's interface is great if you know what you're looking for, but it's not designed for browsing. The interface designed by ZDI is better



Putting PC Magazine *on CD-ROM revealed the power and pitfalls of the technology.*

Illustration by J.D. King

for browsing but not so good for searching for specific information. Windows Help is somewhere in the middle.

Which is the right UI? We don't know. That's one of the reasons we're looking for feedback from our readers. I suspect that the ultimate UI will combine what's best in all these interfaces.

TODAY'S HEADACHE

One thing you will not find on our CD-ROM is any editorial video. This was a tough decision, but the truth is that, currently, not much of our editorial is designed for video. We could have done a short introduction to the disk in video, but there were several technical problems we couldn't solve to our satisfaction in the time we had.

To begin with, Windows does not ship with a video viewer. So we would have had to include one on our CD. That's a problem, in part because we didn't want to force people to install a new driver and in part because we didn't have enough time to evaluate compatibility questions. Also, video technology is very much in flux, and we were looking for something that looks good on all sort of systems.

Not that we haven't worked with video. For another project, we recently did a demonstration of video moving over a network. After a lot of practice and experimentation, we ended up doing an impressive demonstration of video using MPEG compression in an OLE object embedded in Compel multimedia presentation. The final result worked well, but along the way we learned some hard truths about today's PC video technology.

The size of a video file varies dramatically according to the video compression/decompression scheme you use. Also, some video drivers didn't display correctly on all systems, and for reasons we still can't explain, a number of applications occasionally locked up when video was installed. We eventually got video working well for the demonstration, but the experience proved to us that video technology still has a long way to go.

Despite these problems, video on the PC *is* getting better. The next generation of video software, multimedia creation tools, and video playback hardware should solve most of the problems we found. So who knows? Maybe we'll have video on our *next* CD-ROM.

The creation of the CD-ROM and our work with video has been very interesting and a lot of fun for everyone involved. It also provides further proof of how much we learn by actually trying to use all this technology. Seeing multimedia demonstrations and writing about them is interesting. It's even better when we can actually use these applications and test them in the labs. But using the technology in a *real* project has given us a better understanding of its benefits and the problems that weigh it down.

One thing is certain: Everyone involved with the production of *PC Magazine CD* is convinced that electronic, interactive magazines, whether distributed on-line or via CD-ROM, have a tremendous amount of potential as companions to printed magazines. We are also convinced that all the CD-ROM multimedia publications you're seeing now are still works-in-progress.

The real question is whether the *PC Magazine CD* we created is what users want. In that regard, I guess that makes us just like any other software developer.□

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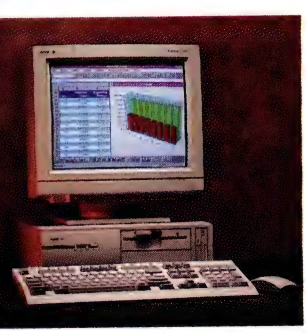


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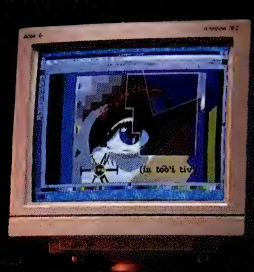


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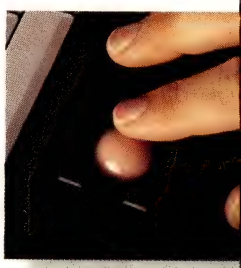


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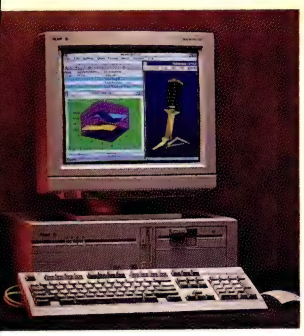
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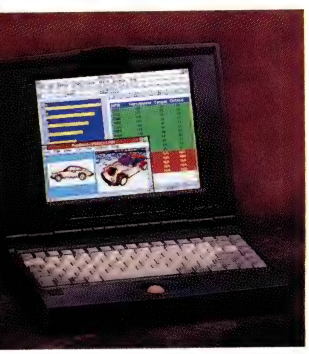


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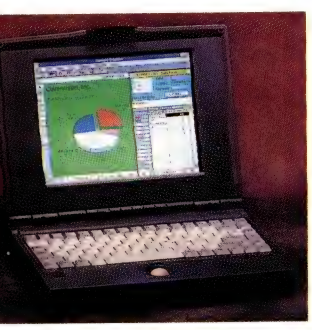


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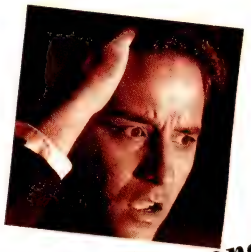
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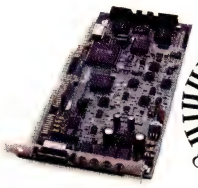
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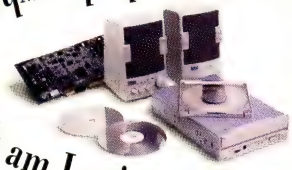
In desperation I asked my friend about Multimedia. She said it's simple. To turn your computer into a multimedia funhouse you need an award-winning Pro AudioSpectrum™ 16 sound card. Sounds great I said. But she wasn't done. I should also get a great CD-ROM drive and a pair of amplified speakers so I can walk through the jungle, talk to Columbus or even explore a haunted house. And all this stuff should be easy to use and set up in my computer automatically. So I asked—where the heck am I going to find all this in one affordable package?















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Bill Machrone

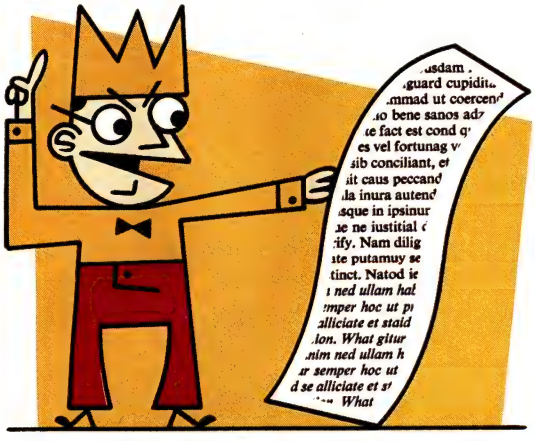
Revenge of the Nerds

George McFly triumphed over Biff Tannen in *Back to the Future*. Rick Moranis, as Wayne Szalinski, won out over the evil forces of pragmatism and greed in *Honey, I Shrunk the Kids*. And in real life, nerds are in big demand. Quants run Wall Street. Windows programmers write their own tickets in the job market. Brainpower is in; the jocks are in full retreat. Marketing campaigns target computer nerds because they tell everybody else what to buy.

Nerds are good consumers, too. A recent survey of PC end users by TechScan Inc. says that if you have a home computer you're much more likely to own other state-of-the-art consumer electronic devices, such as camcorders and cellular phones. For instance, 72 percent own answering machines, as opposed to a 43 percent national average. Apparently, if you can harness one technology, you're likely to harness others. No wonder nerds are in the driver's seat when it comes to guiding the purchase decisions of the technically challenged.

When they tell others what to buy, do they say, "Don't buy IBM?" That's what a recent article in *Business Week* asserted. The article identified gotta-have-it-all technology gurus as a $5 billion market, and they come from every walk of life. (Of course, if you've been reading *PC Magazine* for any appreciable amount of time, none of this comes as a surprise to you.) I was surprised by one aspect of the article, though, where it asserted that nerds think that IBM builds overly conservative, underperforming machines. This didn't sit well with me. In the past, buying an IBM machine generally meant that you worked in a True Blue shop or had more money than brains. And when IBM was mired in the doldrums of its 286-based lineup, they did have a performance deficit. But no more. Some of the speediest machines ever tested by PC Labs have worn the IBM label.

Puzzled by this contrast/quandary, I decided to check with some truly knowledgeable nerds, the folks who hang out on *PC Magazine*'s Editorial forum on ZiffNet. I posed the question, "Do hackers hate IBM?," and cited the *Business Week* article. I asked if they'd be embarrassed to have a current-generation IBM machine, especially an Ambra or ValuePoint, on their desks. I was surprised by the responses, not for the position they took, but for their vehemence. Almost everyone who responded had something nice to say about IBM, or at least some aspect of IBM. Many lauded the ThinkPad line and cited it as IBM at its best. But several wished they didn't have to pay top dollar for all those desirable features. Clearly, however, carrying a ThinkPad is an enormous status symbol among nerds and normal businessfolk alike.



Suffer no more at the hands of your less-technical friends. Brainpower is in.

Illustration by J.D. King

SALUTE OR SLUR?

One of the more interesting comments (and backhanded compliments) came from Ed Bauman, who claims that the IBM stuff is overbuilt. Why design equipment that will last for a decade or more, he reasons, when it's going to be replaced long before it expires from old age? Why, indeed? Planned obsolescence is what got Detroit into so much trouble, and the damage took decades to undo. Should a product be built no better than it needs to be, in the knowledge that it'll be cast aside by its original purchaser in a couple of years? The idea is repellent to me, but producers of "good enough" machines cut costs, boosted margins, and ate the first-tier manufacturers' lunch in previous years.

Another frequent PC MagNet participant, Bill Beem, cited IBM's great DOA record, one of the lowest in the industry, and its high standing in recent *PC Magazine* Service and Reliability surveys. Beem has run an all-IBM shop at a bank and has nothing but praise for the ease of maintaining and upgrading

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Bill Machrone

Micro Channel machines. Unfortunately, his enthusiasm for PS/2s failed to find many sympathetic voices. The others agreed that the PS/2s are well built mechanically but that the architecture seems not to have borne fruit except in high-end file servers. I've always encouraged IBM to build high-performance ISA machines that match its PS/2 line in performance and let the customer decide. This strategy is obviously working, as the recent dramatic upswing in market share (a 35 percent gain) would indicate.

Perhaps I shouldn't have put too much stock in the *Business Week* article after all. Upon rereading it, I examined the accompanying photograph. In it a young playwright, surrounded by equipment, has his hand resting fondly on a ThinkPad 720c. On top of that, it misattributed an article about a popular *PC Magazine* utility, WinCMD, to *Byte*.

YOU'LL LAUGH OUT LOUD

Once upon a time, there was nothing funny about computers. Everything in this business was deadly serious. Fortunately, that's changing as PCs enter the mainstream. I just read Matthew Lake's book, *Breaking Into Windows*, published by ZD Press. Lake writes for our sister publication, *PC/Computing*, and takes a very lighthearted approach to the serious business of learning Windows. The book's subtitle is, "Subvert the system with these shamelessly trivial time-wasting tricks, toys, and techniques." Under the guise of wasting untold amounts of time, you're guided through many of Windows' back alleys and uncharted pathways. When you emerge, you have a newfound sense of the subtleties and undocumented aspects of Windows that affect your everyday applications. As the author points out, "Occasionally, I have to concede, you'll find a procedure or tip that will come in handy when you have to do work in Windows. I offer no excuse for the useful tips that slip in, except to say that sometimes you have to save a little time at work to waste it later in frivolity."

The book includes a disk with some useful shareware, freeware, drivers, and resource files. Armed with the information in this book, you'll become, by degrees, an utter pain to your coworkers, a knowledgeable Windows hacker, and an indispensable, if annoying, fountain of knowledge. You'll get a kick out of Lake's wacky, unconventional approach, too.□

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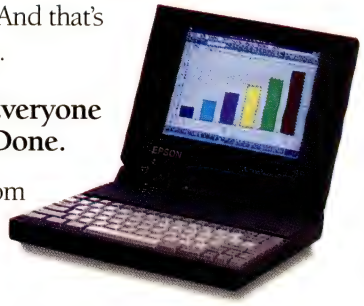


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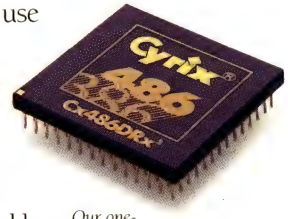
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John C. Dvorak

Some Sound Advice

Now hear this: It's time to put sound on your computer once and for all. With today's high-performance PCs, it's nuts not to have a good sound board and a couple of speakers. Unfortunately, the sound scene is confusing. There are dubious standards and at least one dead-end trend: FM synthesis. Let's try to understand the scene a little better.

FM synthesis is the sound you get from an electronic synthesizer. The sounds are generated from synthetic waveforms, and they sound artificial. Although you can get a nice harmonious string-like sound, you can also get a sound best described as a buzz saw cutting through a cement sewer pipe. FM synthesis was first popularized on the PC by the Ad Lib sound board, and then taken to new heights by the Sound Blaster.

Such boards are all based on an inexpensive Yamaha sound chip that uses a technology patented at Stanford University and licensed exclusively to Yamaha. Newer wavetable synthesis technology is far superior. It was originally developed for professional musicians and was first popularized by E-mu. Then Turtle Beach put it into PC products, and Roland introduced a couple of complex systems that were heading in the same direction. Wavetable synthesis takes the actual sound of a musical instrument and extrapolates upon it to produce the entire range of sounds that an instrument can make. The high-quality samples are called wave files, waveform files, or wavetables—not to be confused with a .WAV song file. Done right, this kind of board sounds fantastic. It's generally accepted that Roland's current offering, the $599 RAP-10 board, is the best in the business.

While a typical FM synthesis board has two channels of sound and maybe four to ten buzzing voices, the RAP-10 has 24 digital channels of true 16-bit sound, and uses a full MIDI (musical instrument digital interface) complement of instruments. The minimum MIDI requirement is the ability to create 128 pitched instruments, each able to produce 24 notes on 16 different channels. Roland puts all of these wavetables in high-speed ROM.

Advanced Gravis's $199 UltraSound takes these concepts even further. This board, which has an astonishing 32 digital channels (14 at the full 44 kHz, 16-bit sampling rate), uses a RAM-based system. You keep the wavetables on your hard disk, and you can swap them out. If you don't like the sound of an acoustic guitar, for example, you can replace it with a third-party audio wavetable sample. And the board, which is MIDI-compatible as well, sounds great. Unlike the RAP-10, the UltraSound has a Sound Blaster emulation mode so good that it sounds better than the Sound Blaster itself.

The straw that will break the back of FM synthesis is, ironically, Yamaha's latest move into DSP (digital signal processing) chips. The newest Yamaha chip, the OPL-4, will have wavetable synthesis as well as backward compatibility with the old FM synthesis. There are other music generation techniques that you might hear about as well, such as phase modulation (used by some Casio keyboards) and a variation of FM synthesis called wave guide.

Over time, you'll discover that FM synthesis belongs only in Nintendo boxes. It's only by a fluke of marketing that we're tolerating this cheesy sound on the PC. I recommend the UltraSound for starters. It's sold for as little as $140, and except for an awkward installation program, the board is outstanding. It comes with plenty of interesting bundled software and works beautifully with Microsoft Windows.

The drawback to this sound board scene: It can be a big distraction and a horrendously mesmerizing time-waster. Of course, that's a problem with anything that's fun.



With new wavetable synthesis boards, we don't have to tolerate cheesy sound on the PC anymore.

Illustration by J.D. King

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John C. Dvorak

Inside Track

The Mysterious TI Connection: So Texas Instruments rolls out its 486 chip based on some licensing deal with Cyrix. Cyrix, which is a small-time operator compared with TI, has a group of ex-TI people who worked on the design of the Cyrix clone chips. Now the megacorporation Texas Instruments decides to get into the act. I have to **wonder** if the entire Cyrix adventure wasn't a TI **plot** to get into a position in which TI could safely make 486 chips without going through the never-ending legal hassles experienced by AMD. Cyrix is like a foil for TI. Cyrix takes the heat and would be only liable for a limited amount of money if it lost some huge suit brought by Intel. If Cyrix weathers the storm, then TI can jump onto the bandwagon. As a bonus, Cyrix goes public and all the "pioneers" get **filthy rich.** This could be **a model for future corporate development** where patents and trade secrets are involved. The key to spotting this **trick** is finding the **silent partner.**

IBM is rolling out its new Mwave DSP chip, which can be programmed to handle anything from music synthesis to voice mail to V.FAST modem communication. Keep an eye out for this chip.

Texas Instruments is involved in a lot of **oddball deals.** IBM is rolling out its new Mwave DSP chip that can be programmed to do anything from music synthesis to phone mail to **V.FAST modem communication.** Best Data Products is the first modem maker to use this thing. Apparently, TI helped develop it as part of a joint venture with IBM. Keep an eye out for this chip in a lot of products.

I want my ISDN! While on the subject of odd situations, I have to make a comment about the strange "information highway" deal made when John Malone sold Tele-Communications Inc. (TCI) to Bell Atlantic for $33 billion. If you haven't noticed there's been **a lot of activity and chit-chat** about anything remotely related to the so-called information highway. In fact, all this fuss is no different than other **financial fads,** from the conglomerates in the late sixties to the leveraged buyouts and junk bond financing of late. What's interesting to me is how this whole deal was carefully orchestrated over a period of time. A year ago, John Malone was a fairly unknown figure. Then, he suddenly became a household name overnight, the smartest man in the world who was going to **take over everything.** Overnight he sells out. Talk about a guy who knows when to get out at the top. As for any of this contributing to the information highway, forget it. The phone company already has the technology for the future. It's called ISDN. So it **stupidly** buys a cable TV network.

More Dubious Ventures Dept.: So what's Apple Computer's objective in bringing out one of those CD-ROM's full of software? It's doing this for the Mac and PC markets. This is in conjunction with more and more talk about Apple's **System 7 being ported to the Intel chip set.** Pundits all say that Apple has always been a software company and now they're realizing it. In fact, the only reason people buy a Mac is for the software. So I suppose that this synopsis is true. What is overlooked in all this is that Apple's System 7 on the PC **misses the whole point:** control of the hardware platform. Putting System 7 on the PC subjects it to the same idiotic BIOS flaws that plague DOS, NeXTStep, OS/2, and Windows NT. There will **never be enough device drivers** written for System 7 for it to become a factor on the PC. These "flaws" may actually hurt the overall image of Apple.

In a related item, insiders note that Apple has purchased a lot of **property in the Austin area,** and people assume that the company is going to move there. Well, I suppose if it's serious about getting into the PC side of the industry it may as well move to Texas where most of the players are located. My advice: **sunscreen.**

IBM shortages explained: Nobody at IBM will admit this, but the company has a history of manufacturing a limited number of units of any one product and then moving on to something new. In the case of laptops, this may not be a bad idea and might account for the **never-ending shortages** of IBM ThinkPads. Rumor has it that the company determines the market potential for a given machine. It makes the machines and then stops and goes on to the next machine and makes a predetermined number and then stops—and on and on. Does this sound like the old **Stalinist economic system** to you? Anyway, this technique only works if you're at least in the ballpark with reality. The popularity of the ThinkPads and subsequent shortages says to me that these guys are in the wrong park too often. IBM could be making a **killing** with these machines. Then again, maybe that big screen is actually in short supply.

Genuinely Interesting Software Dept.: Remember when you were a kid and someone would show you a satellite zooming across the sky? You can now look for that zooming orb with Satellite Pro from Zephyr Services (412-422-6600). Satellite Pro is an earth satellite tracking program for optical and radio tracking of any satellite for which a standard NORAD 2-line Elset is available. The program can "fly" 200 satellites simultaneously and manage **a database of 20,000 satellites.** Satellite Pro is the perfect wacky nutball gift for the engineer who has everything. The price is $149.□

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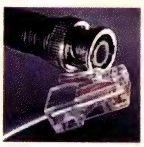
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Jim Seymour

The Best *Ideas* of 1993

It's not that great ideas are a dime a dozen in the PC world, but great *products* are what we usually think count most in the PC business. You can have all the clever ideas you want about new kinds of computing and new kinds of computing tools, but until those ideas turn up in real products—where the rubber meets the road, to borrow a cliche—they don't have much impact.

Thus, most year-end issues of computer magazines are full of columnists' ruminations about the whizzy products they saw over the previous 12 months. Readers like that: If you're in the market for a new doodah, learning that So-and-So thinks the Whomp-O Model 7 doodah is among the best new products of the year is useful. Vendors love 'em, too. Lines such as "*Highly recommended*!—Dvorak," or "*Best yet!*—Miller," or "*Buy this one!*—Seymour" move a lot of product—out the door.

But this year I'd like to step back for a more fundamental view. Given the focus on implementations, we often pay too little respect to ideas in the PC business. Yet in 1993, we saw new, powerful, and fundamentally different ideas come to the fore. They were expressed in fine products, but the underlying ideas were most important.

Instead of plowing the old faster/smaller/cheaper path, these ideas have begun to change how we use computers and, in some cases, how we work.

I could list a dozen paradigm-shift ideas that came to fruition this year, but I've chosen six I think capture the year and its changes.

The delivery of the first PowerPC- and Alpha-based systems this year marked a critical turning point in personal computing. Breaking out of the Intel *x*86-architecture box opens worlds of potential improvements in performance and usability.

Moreover, moving Windows NT to both of those new chip architectures starts to break down foolish walls between kinds of work and the computers we've historically chosen for that work. As NT applications begin to appear, we can scale the underlying hardware platform to the nature of the specific user's work, but offer common applications to all users.

Although Digital Equipment Corp.'s Alpha is interesting, I'm convinced that it's the PowerPC series—especially the 620s, due in 1994—that will really change our perception of chip architectures and desktop computers.

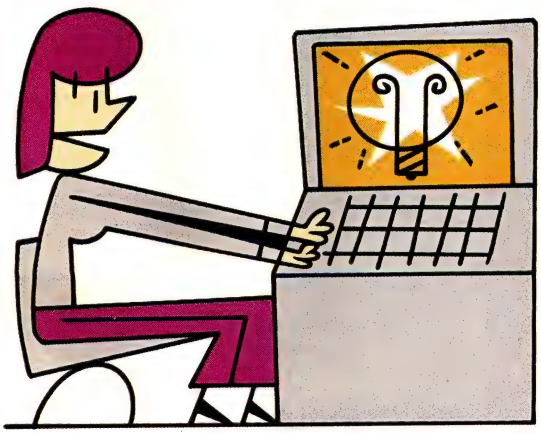
The Plug-and-Play BIOS spec, developed by Microsoft, Intel, and a raft of PC makers, has importance well beyond the obvious. Originally, Plug-and-Play looked as if it were about making PCs easier to set up and expand, without worrying about DIP switches, software configuration of hardware add-ons, and tedious manual resolution of hardware conflicts.

A MAJOR SPEC

But late this year, Phases I, II, and III of Plug-and-Play's notebook-PC services were announced, and now we see just how important this spec will be. By letting notebook users quickly and easily attach and detach from docking stations connected to LANs, this extension of the original easy-setup Plug-and-Play notion makes mobile computing far more practical. As notebook PCs get closer to replacing desktops, effortless linking to and unlinking from the LAN become not merely convenient but essential.

The 32-bit operating systems came of age this year with OS/2 2.1 and Windows NT. OS/2 now has the drivers and Win 3.1 and TrueType support it needed to be a viable choice; NT will get even better in 1994 (and be joined by Windows 4.0/Chicago), but it's mighty impressive right now.

The era of 16-bit operat-



When you look back at 1993, you'll see great ideas that helped change the way people work with their PCs.

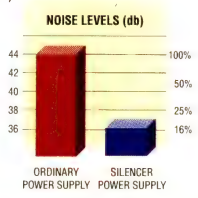
Illustration by J.D. King

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"If you value quiet, get the Silencer" *Business Week,* Sept. 18, 1989

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Jim Seymour

ing systems is over; the rewards of 32-bit OSs' multithreaded execution and clean multitasking are too great to ignore. Those who point out that few users of yesterday's feeble multitasker (Windows 3.*x*) use that capability miss the point. That's like saying few people in Siberia speak French: They never had the chance. Nor the reason.

PCMCIA cards grew up this year. Sure, there are still problems running some Type II PCMCIA devices in what are supposed to be standardized Type II sockets. But there are plenty of reliable, highly compatible PCMCIA cards available now, serving as modems, LAN adapters, SCSI interfaces, external-video interfaces, digital-paging receivers, even Global Positioning Satellite-based ground-locator systems.

PCMCIA is one of the buses of the future. Not *the* bus of the future, mind you: just one of them. As Intel's Peripheral Component Interconnect (PCI) bus moves to the foreground for inside-the-box connections, PCMCIA will become the quick way of making external bus-level connections.

This was the year of color displays in notebook PCs—bright, accurate, active-matrix displays. Display-makers' yields are rising and prices are finally falling—just in time, since buyers, having seen today's best color displays, don't want to put up with 64-levels-of-mud murk-scale displays any longer.

Remember how quickly color displays replaced monochrome "green screens" on the desktop once affordable VGA-resolution color monitors became available? You'll soon see the same switch in notebook displays.

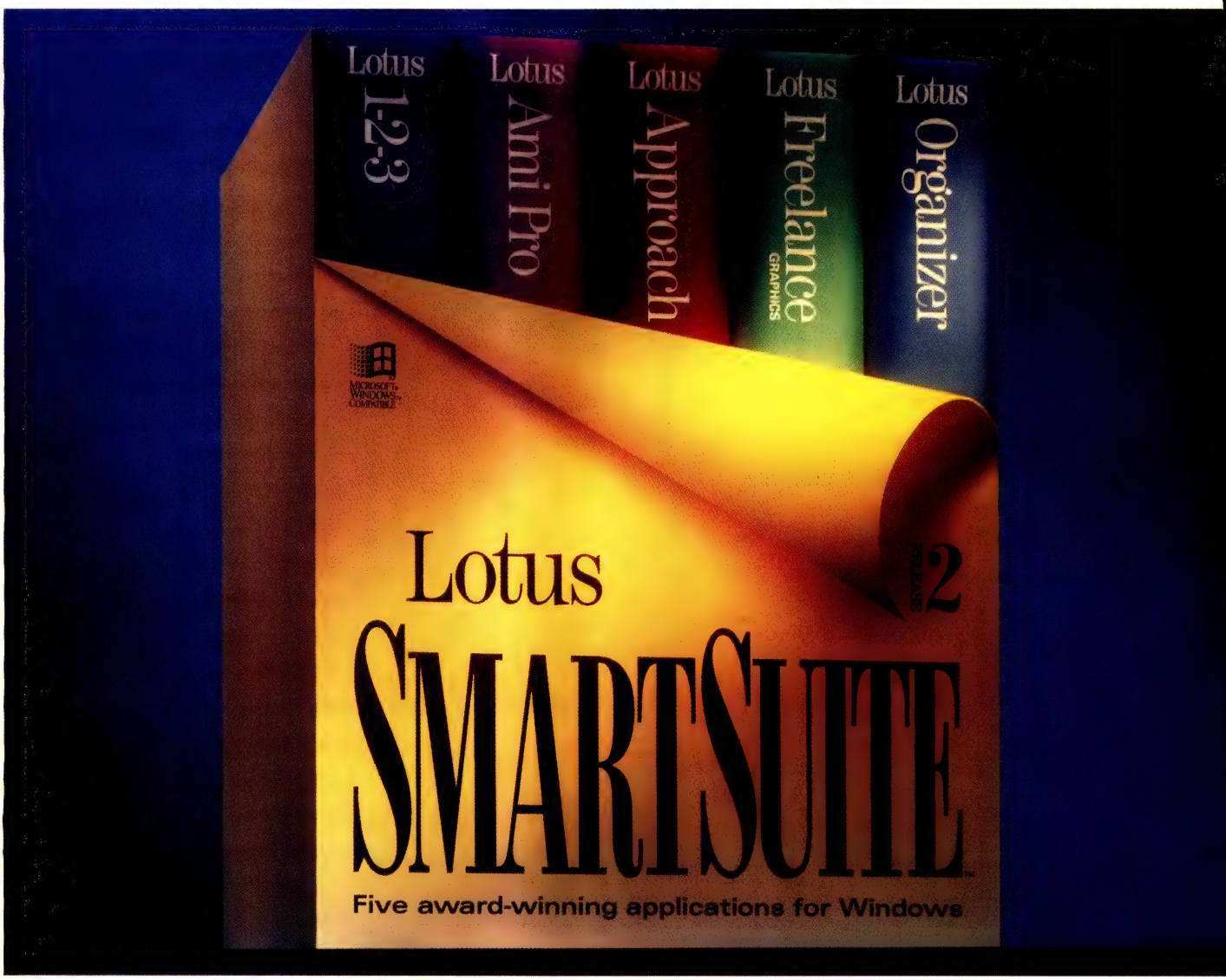
Finally, mobile computing in general has taken off, even if that isn't yet widely recognized. In retrospect this will, I suspect, be the most important legacy of 1993 in computing: that the *idea* of being able to take your computer—ONE computer, which you use wherever you are, at your desk or away—is becoming accepted as the norm.

AT&T, Hewlett-Packard, Motorola, IBM, Apple, and a few other companies have grabbed the early lead in mobile computing. How well they work together on the ideas behind mobile computing will determine how quickly the mobile computing revolution sweeps through our lives.

Of course products are important. But the ideas behind them are what shape and reshape our lives.□

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IN OUR SUITE.

gathering of five leading Windows applications would be to miss the big story.

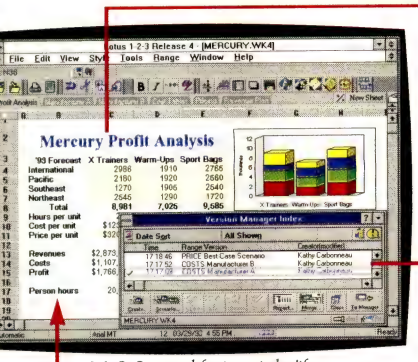
ALL TOGETHER NOW.

The five applications in SmartSuite also set new standards for integration.

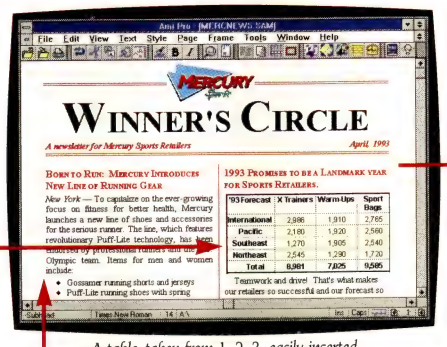
(Our leading competitor boasts that its spreadsheet, word processor and presentation software will have some consistency too . . . when the new releases are ready.)

Lotus also leads the way for sharing information across applications and using functions from one application while working in another. This goes beyond basic OLE and DDE through a feature called Collect and Copy that automatically forms links between applications.

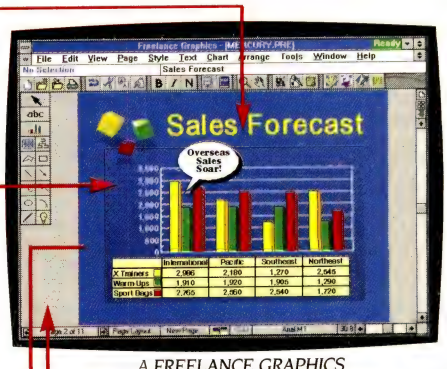
With a single mouse click you can easily edit 1-2-3 charts from within Freelance Graphics. You can seamlessly perform a mailmerge in Ami Pro with data from Approach.



A 1-2-3 spreadsheet created with data from the Approach database.



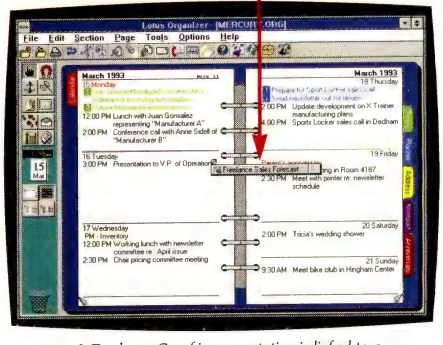
A table, taken from 1-2-3, easily inserted into an AMI PRO newsletter.



A FREELANCE GRAPHICS presentation made from an Ami Pro outline, including charts from 1-2-3.



APPROACH lets you manage the data you use in your other SmartSuite applications, especially 1-2-3.



A Freelance Graphics presentation is linked to a meeting scheduled in ORGANIZER.

First, to make it all easier and reduce training costs, they offer consistent appearance and behavior between applications. For example, SmartSuite applications share common menus, Live Status Bars and SmartIcons.® In fact, 1-2-3, Ami Pro and Freelance Graphics share 26 common SmartIcons.



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Or link a Freelance presentation to a meeting agenda in Organizer. For more information on SmartSuite and this special $299 offer, just turn the page.

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> *Lotus SmartSuite redefines how applications should work together, making complex cross-application tasks accessible to the vast majority of Windows users...*
> PC/Letter, 6/7/93

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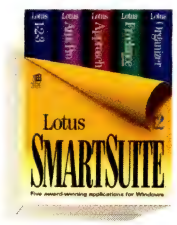
> *Lotus now has a top-rated product in each of a half a dozen categories... Moreover, Lotus products have come to share a great deal of genuine integration.*
> Soft* Letter, 5/21/93

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> *Lotus's Version Manager blows away similar features in Excel or Quattro Pro.*
> Wall Street Journal, 7/29/93

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Bill Howard

Transferring to the Red-Eye

In the future, the connections that matter between PCs will run at either 100 megabits per second or at about 1 megabit per second. Of the slow-speed transfer methods, I'm most enthusiastic now about low-power infrared. Infrared (IR) is the technology at work inside the remote control of your TV set. It's cheap, effective, doesn't cause cancer in laboratory mice, and is not being studied to death by standards committees.

The infrared technology I like is the serial infrared (SIR) specification established by Hewlett-Packard, which has made it freely available for use by other producers of desktop PCs, laptops, servers, and printers. It's on HP's 3-pound OmniBook 300 notebook computer, many of HP's new desktop PCs, and on HP's palmtop computers. (An incompatible form of IR is on Apple's star-crossed Newton MessagePad and Sharp Wizard hand-held organizers.)

TWO OUT OF THREE

A fundamental rule of connectivity is at work with SIR, which states that "You can have fast, reliable, or cheap networking—but only two at a time." Most of all, SIR is cheap: A dollar or two worth of parts, and an ounce or two of weight. *Least of all* is it fast: It runs at 115 kilobits per second, plus compression—about as fast as a floppy disk drive. In practical terms, that means about a third of a second to zap this column from my laptop to my desktop PC.

HP's competitors warily circled the SIR spec at first, concerned that adopting the HP spec would give HP a leg up on the competition. Virtually everyone has decided it won't, so over the next few months you'll see a flurry of SIR announcements from *other* vendors. Many are talking about a superset of the HP specification that will support HP and HP-style devices, but also offer more distance, a wider angle of acceptance, and possibly faster throughput. HP's SIR works at distances up to one meter, and the two devices have to be pointed directly at each other.

All this is point-to-point, or line-of-sight, infrared. There's also diffuse infrared, used in wireless extensions to wired LANs, from companies such as A.T. Schindler Communications, IBM, InfraLAN Technologies, and Photonics Corp. The signal can be bounced off walls and ceilings, but that takes more power and the circuitry takes up more space. Neither form of infrared can go through walls.

SAFETY AND EXPECTATIONS

For all kinds of IR, there's a perceived safety advantage. Wireless RF devices get dinged now and then as possible health hazards—remember the cellular phone scare?—but *everyone* agrees that infrared is harmless.

Look for real notebook computers appearing by early 1994 with infrared ports. The minimal cost and bulk of IR will be buried in the system. Notebook users will be able to swap meeting notes before leaving the conference room or print them out with an infrared attachment to a printer. The first such attachment capable of infrared printing is the JetEye, $159, from Extended Systems (800-235-7576; 406-585-3650). Its sister product, the JetEye PC, $149, connects to a PC. To squirt a file to a desktop PC using the JetEye PC, you run a file transfer program such as LapLink or load a device driver that lets the other system act as a remote disk drive.

If you want to transmit through walls but still want cheap, *personal* connections, look into Traveling Software's new LapLink Wireless 1.0, an audiocassette size RF transceiver that connects to your serial port and can send data at least 30 feet at speeds of 115,200 bps. At $259 (list) for a pair, this is the equivalent of infrared with X-ray vision.□



Wired data transfers rule the day, but infrared data transmission is still in the air.

Illustration by J.D. King



20 years.

100,000 men.

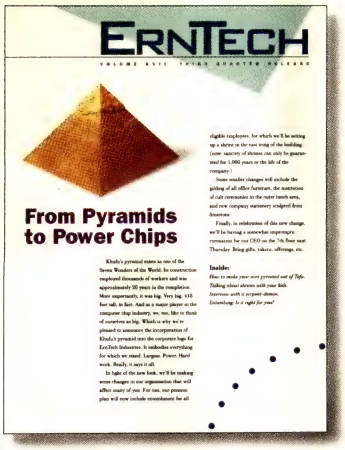
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Max. Resolution	1024x768/87Hz	1024x768/60Hz	1024x768/72Hz	1024x768/72Hz	1024x768/72Hz	1280x1024/60Hz
Digital Control	--	--	--	--	Yes	Yes
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• *Ten Years of Achievement*

THE 10TH ANNUAL AWARDS FOR TECHNICAL EXCELLENCE

BY MICHAEL J. MILLER

Every year, the PC industry proves itself to be an amazing source of innovation and creativity. Ten years ago, the 80286 PC defined the state of the art and Lotus 1-2-3 represented the cutting edge of interface design. Now, as we present *PC Magazine*'s 10th Annual Awards for Technical Excellence, clock-doubled 486 chips and sophisticated graphical interfaces are the mainstream as the industry looks toward powerful new generations of processors, advanced operating systems, and seamless cross-application integration.

All this is due to the work of many dedicated designers, programmers, engineers, and scientists who have worked hard to push the boundaries, to take technology to the next level. These awards, based on the judgment of *PC Magazine*'s editors, labs personnel, and contributors, salute the finest of these contributions. To be considered, products must have shipped between October 1, 1992, and September 30, 1993. The winners and finalists spotlighted on the following pages are testaments to how far we've come in personal computing, and what the future holds.



PHOTOGRAPHY BY THOM O'CONNOR

• Components

This year, we saw records shattered as the quest for speed continues. Our nominees bring workstation-class processor architectures to PC chip designs, offering new levels of horsepower on the desktop.

WINNER

Intel Pentium



VIN DHAM, AVTAR SAINI, JOHN CRAWFORD, JOE MONTGOMERY, DON ALPERT, KEN SHOEMAKER, DROR AVNON, ED GROCHOWSKI, JIM MILLER, GADI SINGER

The Intel Pentium processor was the chip we all wanted—but few of us could actually find—in 1993. The Pentium design rests on a baseline of 80*x*86 compatibility, offering instant support for a multi-billion-dollar installed base of software, but the chip's 32-bit superscalar architecture breaks significant new ground. Highlights include its dual five-stage instruction pipelines, separate 8K code and data caches, branch-prediction logic, and a 64-bit external-bus interface running at the full internal chip speed. The completely revamped floating-point unit, significantly faster than the 486's 80387-compatible FPU, is a match for demanding workstation applications. Still, the Pentium is a work in progress. Initial availability was limited, especially for the higher-speed, 66-MHz version, and prices remain high. The chip is also larger and hotter than ideal. We hope a low-voltage design and Intel's newer, 0.6-micron process will leap these hurdles in 1994, when Pentium-based machines will ship in volume. Although scarce today, they offer screaming performance with off-the-shelf software and promise even more with the advent of Pentium-optimized applications.

• *Intel Corp., 2200 Mission College Blvd., Santa Clara, CA 95052; 408-765-8080.*

FINALISTS

Digital Alpha AXP DECchip 21066

DANIEL DOBBERPUHL, RICHARD WITEK, RICHARD SITES, DAVID CONROY

The Digital Alpha family and its new PC-class member, the DECchip 21066, offers a compelling alternative future for PC processor design. A 64-bit RISC architecture running at speeds up to 166 MHz, the DECchip 21066 is built to power everything from desktops to VAXes. Supported operating systems include Digital's OpenVMS and OSF/1, and most significantly, Microsoft Windows NT. The DECchip 21066 boasts a state-of-the-art superscalar design with fully pipelined integer and floating-point units and two integrated 8K caches. PC-centric features include a PCI I/O controller and embedded graphics accelerator. Bridging the gap between PCs and workstations, the DECchip 21066 promises to bring RISC horsepower to everything from scientific applications to client/server computing—at a highly competitive price.

• *Digital Equipment Corp., 77 Reed Rd., Hudson, MA 01749; 800-332-2717.*

Weitek Power 9000

WEITEK POWER 9000 DEVELOPMENT TEAM

In a year when video chip manufacturers continued playing leapfrog, reaching ever-higher Microsoft Windows speeds with new designs, Weitek Corp. stands out. Its Power 9000 chip, derived from the company's W8720 workstation graphics accelerator, was the heart of most of the fastest graphics cards we tested in 1993. While marginally speedier competitors are already on the horizon, the P9000's 24-bit color prowess at high resolutions remains unchallenged. Given Weitek's impressive history in coprocessor design, this comes as no surprise. Built for a VRAM frame buffer and a 32-bit RAMDAC, this chip was not designed to be the lowest-cost solution. But whether running today's top Windows applications or blasting through synthetic tests of raw graphics performance, the P9000 was the video chip of choice in 1993.

• *Weitek Corp., 1060 E. Arques Ave., Sunnyvale, CA 94086; 408-738-8400.*

Systems

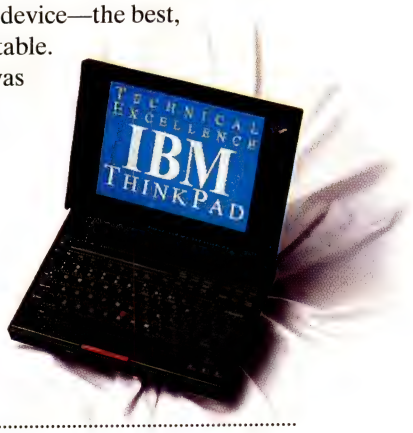
Portable computing achieved the year's biggest breakthroughs. High-end models reached new heights and color quality while smaller subnotebooks set size and performance records.

WINNER

IBM ThinkPad 700C Family

KOICHI HIGUCHI AND THE THINKPAD DEVELOPMENT TEAM

Even our most skeptical editors agree on this one: The IBM ThinkPad 700C family goes so far beyond the competition that it defines a new standard in portable computing. Quite simply, this is the best integrated notebook series we've ever seen. These elegant machines sport a beautiful 10.4-inch, 256-color active-matrix LCD screen; great keyboards; and the IBM TrackPoint II pointing device—the best, most innovative way of moving around in Microsoft Windows we've seen in a portable.



Impressively, IBM has upped the ante twice this year. The ThinkPad 700C was based on IBM's 25-MHz 486SLC processor. Its successor, the ThinkPad 720C, had IBM's clock-doubled 50-MHz 486SLC2 processor and full PCMCIA support. The latest machine in the line, the ThinkPad 750C, uses Intel's 33-MHz 486SL processor, adds more hard disk storage (up to 340MB) and offers integrated 16-bit sound support—yet is even lighter than its predecessors. The distinctive black design includes a pop-up keyboard that gives access to removable components, including the hard disk and nickel hydride battery. To those who feel that IBM missed the boat in previous years' portable designs, we say that the ThinkPad series is a stunning comeback.

• *IBM Personal Computer Co., Rt. 100, Somers, NY 10589; 800-772-2227.*

FINALISTS

HP OmniBook 300

TIM WILLIAMS, JERRY ERICKSON, ERIC VOGEL, JIM DICKIE, AND THE HP OMNIBOOK 300 DESIGN TEAM

The best-conceived and -integrated of the ultraportable subnotebooks we've come across, the diminutive HP OmniBook 300 takes a Microsoft Windows system to enviable smallness. Weighing less than 3 pounds, it offers a full-size keyboard, a VGA-resolution screen, and a nifty mini-mouse that pops out from the side of the case. The unit's 3.3-volt AMD Am386SXLV/20 processor delivers adequate CPU power, and its rechargeable batteries—you can substitute four standard AA cells—deliver five to nine hours of use. On the software side, Windows and an impressive collection of Microsoft apps (including Microsoft Word and Microsoft Excel) are stored in ROM and are instantly accessible at power-up. Mass-storage options include a 40MB PCMCIA hard disk or a 10MB flash memory card. With plenty of well-designed features, the OmniBook is a model of small but powerful computing.

• *Hewlett-Packard Co., 1000 N.E. Circle Blvd., Corvallis, OR 97330; 800-443-1254.*

ZDS Z-Lite 425L

THE 425L DEVELOPMENT TEAM

Little machines popped up everywhere in 1993, but Zenith Data Systems' Z-Lite series was a standout, excelling because of the amount of power and usability packed into its small and elegant form. The series started with the Z-Lite 320L, a 386SL-powered unit with an exceptionally clear monochrome display, a 61MB hard disk, dual PCMCIA Type II expansion slots, and the detachable LitePoint trackball.

The latest model, the Z-Lite 425L, takes a big step up in power. It has a 3.3-volt Intel 486SL/25 processor and hard disk storage up to 170MB—all this and it still weighs less than 4 pounds without an external floppy disk drive or battery charger. The Z-Lite 425L is the most powerful in its weight class. Throw in the handsome wedge-shaped case with its rounded back and you have one of the most distinctive small notebooks on the market.

• *Zenith Data Systems, 2150 E. Lake Cook Rd., Buffalo Grove, IL 60089; 800-553-0331.*

• Peripherals

Printers and scanners were in the limelight in this year's peripheral-development arena. Color was the major trend as technologies improved and prices fell.

WINNER

HP DeskJet 1200C

THE HP DESKJET 1200C DESIGN TEAM



There was a time when buying a color printer meant you had to settle for mediocre print quality or invest thousands of dollars to get respectable output. Hewlett-Packard's DeskJet 1200C changes that for good, opening the way for color printers to become as ubiquitous as color monitors. With its four-color, 300-dot-per-inch print engine, the DeskJet 1200C produces truly excellent output—the best we've seen from ink jet technology. In addition, it prints on plain paper, glossies, and transparencies. The DeskJet's speed is impressive; we clocked it at 6 pages per minute when printing black-and-white text and almost a full page per minute for full-color images. Generous RAM is a must for color, and the DeskJet 1200C's memory is expandable to 26MB. And by using HP add-on products, you can easily integrate this printer into an Ethernet or Token-Ring LAN. The DeskJet 1200C is easier to use and much less expensive to run than most good-quality color printers. Best of all, you can get all this for a street price of under $1,500 for the HP PCL 5 model; its PostScript-enabled sibling, the HP DeskJet 1200C/PS, runs about $2,000. The color printer market is already showing explosive growth, with units like the DeskJet 1200C blazing the trail.

• *Hewlett-Packard Co., P.O. Box 58059, Mail Stop 5511L-SJ, Santa Clara, CA 95051-8059.*

FINALISTS

Canon Bubble Jet Printer BJC-600

TAKASHI SAITO AND THE BUBBLE JET GROUP

The Canon BJC-600 shows yet another sign of vibrancy in the low-cost color printer market. Its very low list price ($719) and reasonable cost per page (about 15 cents with average color coverage and 4 cents for monochrome) set it apart from the other non-laser color units. It also stands out for its upscale print quality: 360-dot-per-inch resolution and far less banding than is typically seen with ink jet technology. It features a newly designed, four-head CMYK print engine with 64 nozzles on each head and separate ink cartridges for each color. Once an also-ran technology, ink jet printing in color implementations such as the BJC-600 is poised to make its mark.

• *Canon Computer Systems Inc., 2995 Redhill Ave., Costa Mesa, CA 92626; 714-438-3000.*

Nikon Coolscan Film Scanner LS-10

JOHN HARCOURT, PETER PLITTERIS, KHOURI GIORDANO

A slide scanner that's small enough to fit in a drive bay but still delivers professional-quality image files, the Coolscan is a tiny marvel. Listing for an impressively low $2,300, it not only dramatically shortens the image-scanning turnaround time for graphics professionals, but also opens up new horizons as an image source for in-house publishing, presentations, and multimedia databases. The Coolscan handles 35-mm color and monochrome transparencies (positives and negatives) at a maximum resolution of 2,700 dots per inch. At its core is a breakthrough strobing LED technology that makes a three-color 24-bit scan possible in a single fast pass. A SCSI adapter and intuitive Microsoft Windows front end complete the package. The Coolscan is both a good idea and a great implementation.

• *Nikon Electronic Imaging, 1300 Walt Whitman Rd., Melville, NY 11747; 516-547-4200.*

• Networking Hardware

This year's network hardware standouts offer innovative solutions that meet a network manager's most pressing needs: greater reliability, more power, and lower costs.

WINNER

Wellfleet Backbone Concentrator Node



THE WELLFLEET BACKBONE CONCENTRATOR NODE DEVELOPMENT TEAM

Routers are the linchpins of corporate networks: Lose the router and you've lost the net. Wellfleet's Backbone Concentrator Node (BCN) is the first router to give network managers the reliability they need to consolidate network connections into a single box. Instead of tying workgroups to an FDDI backbone, they can be tied to a BCN in what's called a collapsed backbone.

To this end, Wellfleet has designed the BCN with an impressive fault-tolerant design. Hardware fault isolation lets the router automatically insulate a failed network interface card or data path, or insulate a management, processor, or link module. Network managers can also swap out modules and other components while the system runs. Should the software fail, the operating system can automatically detect, isolate, and restart a failed process. The BCN can also dynamically reconfigure itself around a failed component without having to take down the system. Finally, if the system has to be rebooted, the BCN reconfigures itself around failed components. These extensive reliability features are augmented by a powerful symmetrical multiprocessing design, giving the BCN the power, performance, and reliability needed for moving network traffic.

• *Wellfleet Communications Inc., 8 Federal St., Billerica, MA 01821; 508-670-8888.*

FINALISTS

3Com LinkBuilder Stackable Wiring Hubs

THE LINKBUILDER DESIGN TEAM

When users needed an inexpensive way to connect network devices, vendors turned to stackable hubs. Leading that charge is 3Com's LinkBuilder hub line. Like other stackable hubs, 3Com's LinkBuilder lets you connect PCs and devices through inexpensive, nonmanageable hubs. When you need to control that hub, you simply add management to one hub and have it oversee several sister hubs. You add management through the standard Simple Network Management Protocol (SNMP), Telnet, or a separate cable via a terminal.

The LinkBuilder goes a step further by making the hub appear as a single repeater. This lets network managers separate network devices through longer cable runs. This is an effective and inexpensive solution from a classic network vendor.

• *3Com Corp., 5400 Bayfront Plaza, Santa Clara, CA 95052; 800-638-3266.*

Tricord PowerFrame ES5000

JOHN GUIDER AND THE ES5000 DEVELOPMENT TEAM

Weaknesses that are acceptable in a desktop system can be fatal in a network server. The Tricord PowerFrame ES5000, a true superserver, adapts and extends PC technology for the bullet-proof fault tolerance and screaming performance a network demands. Designed as a symmetric multiprocessing platform, the PowerFrame ES5000 runs NetWare or SCO Unix on up to six 486DX2/66 processors. Error-correction-code memory and bus parity checking are combined with a robust modular design where CPU, memory, and I/O subsystems slot into a 64-bit backplane. The long list of features includes multiple SCSI adapters, RAID disk storage, redundant power supplies, and battery-backed software monitoring. Running NetWare, the PowerFrame ES5000 is also one of the fastest systems we've ever tested, a testament to the power of this impressive design.

• *Tricord Systems Inc., 3750 Annapolis Ln., Plymouth, MN 44337; 800-729-5055.*

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LTE Lite Features

3½" 1.44-MB diskette drive • Power conservation and security features • Auxiliary battery • AC Adapter • MS-DOS 6 and Microsoft Windows Preinstalled • EZ Help On-Line Library • Slipcase • Integrated Trackball and an Expansion Base Connector.

Contura Features

3½" 1.44-MB diskette drive • Power conservation and security features • Battery Pack • AC Adapter • Preinstalled MS-DOS 6, Microsoft Windows 3.1 and EZ Help On-Line Library and a COMPAQ Trackball.



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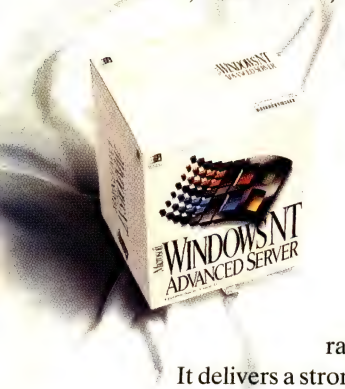
• Networking Software

New server operating systems, application-server technology, and optimized data management were at the forefront of this year's innovations in network software.

WINNER

Microsoft Windows NT Advanced Server

DAVE CUTLER, MOSHE DUNIE, MARK CLIGGETT, LOU PERAZZOLI, LEIF PEDERSON, DAVE THOMPSON, KEN GREGG



Is Microsoft Windows NT a general-purpose operating system or a network operating system? Clearly the answer is that it's both. Windows NT is the first operating system that effectively builds networking into an OS capable of running today's and tomorrow's DOS and Windows applications. It is also the first multithreaded, multitasking corporate operating system that can support as many as four CPUs on symmetric multiprocessing platforms. It offers broad hardware independence, with versions already available that run on Intel 486 and Pentium processors, as well as on the MIPS R4000 family and Digital's Alpha processors.

NT Advanced Server takes this basic feature set and enhances it, adding support for multiple servers and access to multiple domains. It also supports additional RAID configurations and offers network management support as well as connections to Macintosh computers. It delivers a strong platform for client/server applications and offers broad connectivity to existing networks including NetWare and LAN Manager. These features make Windows NT Advanced Server a networking force.

• *Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-227-4679.*

FINALISTS

Conner HSM

GEORGE REA, BERNIE WU, CHRIS TIPTON, TOM PISELLO

Long used on mainframe networks, hierarchical storage management (HSM) migrates infrequently accessed files from costly disk media to less expensive tape or optical storage. The Conner HSM system—a mixed software/hardware solution—pioneers this approach for NetWare. Network files move to optical drives after a user-defined period of inactivity and then to tape after another such period. Retrieval from the Conner HSM storage server is transparent to end users, who see migrated files in the network directories, no matter what the physical storage medium. This lets the system free up as much of the server's local disk storage as possible for optimal network performance. It's a smart idea that many network vendors are imitating, but Conner is a leader.

• *Conner Peripherals Inc., Storage Systems Group, 36 Skyline Dr., Lake Mary, FL 32746; 800-526-6637.*

WINView for Networks, Version 2.01

RICH ANDRESEN, MARC BLOOMFIELD, MIKE DISCAVAGE, ED JANECZEK, SCOTT KINNEAR, JEFF KRANTZ, JEFF MUIR, BRAD PEDERSEN, KURT PERRY, TERRY TREDER

Applications servers are a '90s solution for Windows-hungry corporations with older PCs. They're also a boon for MIS departments struggling to administer applications on PC LANs. Of the application servers we've seen in this new field, the best conceived is Citrix's WINView for Networks. On the server, WINView is a multithreaded, multitasking 32-bit OS/2 derivative that can run multiple Windows apps as threads. On the client, a small Windows-aware program manages screen presentation and user input. Seamlessly integrated into NetWare, WINView limits network traffic to keystroke, screen, and mouse updates. Strong support exists for WAN and mobile connections. WINView for NT is on the horizon, and the company's recently announced partnership with Novell signals formidable new levels of integration.

• *Citrix Systems Inc., 210 University Dr., Coral Springs, FL 33071; 800-437-7503.*

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• Applications Software

As competition intensifies in well-established categories, new concepts and true ease of use are the keys to this year's software success stories.

WINNER

Lotus Improv for Windows, Release 2.1



THE IMPROV PRODUCT TEAM

Improv's multidimensional orientation represents the biggest shift in spreadsheet thinking since the creation of Lotus 1-2-3. The ability to arrange spreadsheet views dynamically lets you see your data in new and revealing ways. Rearranging a spreadsheet is as simple as selecting a category and dragging it from a row to a column, or combining categories to take a quick look at totals. The set-oriented, plain-English approach to generating formulas is often as easy as pointing and clicking on a row or column heading. You are encouraged to write "general" formulas that declare relationships between categories and items rather than using cell references. Together these features bring both discipline and ease of use to spreadsheet-based data modeling.

Improv was originally developed for the NeXT machine, and the Windows version is even smoother and more natural to use. Some data modeling may be creeping into the features set of traditional spreadsheet packages, but Improv was the pioneer.

• *Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 800-343-5414.*

FINALISTS

Quattro Pro 5.0 for Windows, Workgroup Edition

JOE AMMIRATO, ROBERT WARFIELD, DAVE ANDERSON, AND THE QUATTRO PRO PROGRAMMING TEAM

Quattro Pro is back again. Last year, advances such as spreadsheet "notebooks" and a sophisticated query tool made Quattro Pro the winner in this category. This year Borland focused on ease of use and workgroup computing. New interactive tutors show you how to perform various tasks in the program, using your own data. If you like the results, you can keep them; if not, you can revert to where you were before you started the tutor. Quattro Pro also includes a huge variety of electronic "experts" that make it easy to do the kinds of things you always knew your spreadsheet could do, from sophisticated statistical analysis to figuring out the payments for refinancing your house. The Workgroup Edition adds another excellent feature: Object Exchange (OBEX), which lets you publish a portion of your spreadsheet and lets other people subscribe to it, so that changes in one spreadsheet can be automatically brought into other spreadsheets. OBEX is unique in letting you use all kinds of message transports, from VIM and MAPI to MCI Mail.

• *Borland International Inc., 100 Borland Way, Scotts Valley, CA 95066-3429; 800-682-9299.*

WordPerfect 6.0a for DOS

ALAN BROWN, JIM MILLECAM, MERLIN CARPENTER, PERIN BLANCHARD, DAN BAKER, KYLE DENNING, STEVE LOWRY, JONH GAY

Possibly the last and greatest DOS word processor, WordPerfect 6.0a offers the rich graphical features of a Microsoft Windows program with the speed and efficiency you expect in DOS. You can easily switch between text and graphics modes, and the program boasts a fully interactive WYSIWYG mode that puts some Windows programs to shame. It does more than mimic Windows, though. The package includes some great innovations in its own right: built-in fax and hypertext support, a table feature that includes most of the functions offered by a PlanPerfect spreadsheet, an advanced macro language, and sound recording/playback capabilities. Besides being terrific for customers who want to stick with DOS, WordPerfect 6.0a is a crowning achievement in overcoming DOS's barriers.

• *WordPerfect Corp., 1515 N. Technology Way, Orem, UT 84057; 800-451-5151.*


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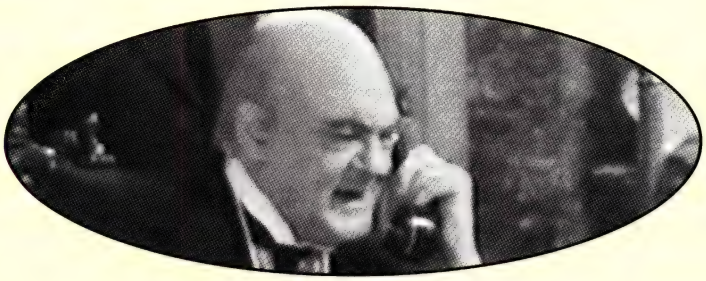
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You've been given a great gift. The chance to see what your life would be like with a brand of computers other than ZEOS. Here's one man's tale.



LATE DELIVERY–When Mr. Potter ordered the *other* brand, he stated specifically that he needed it by the following week to acquire some property. A month later, he was still waiting for his system, and his property deals had fallen through.



ON-HOLD SUPPORT–Old man Potter could barely feel the tiny creature crawling up his arm. He had been listening to the on-hold Muzak on the *other* guy's tech support hotline so long he collapsed from exhaustion. He never did get through–and he never did get rid of that tingly spider feeling.



INEFFICIENT–As a banker and executive, Mr. Potter needs top-notch performance from his PC. But he made the mistake of ordering the *other* brand and that hourglass won't disappear.



LIFE SPAN–The fact that Potter can't repair a leaky faucet and has a hard time with the toaster manual is beside the point. He just doesn't have the time to spend unscrewing, replacing and reassembling his new desktop purchased from that *other* company.



INCONGRUOUS–Potter purchased several systems from one of the *other* guys to hook up to his network at the bank. Poor Mr. Potter couldn't even get them to communicate with each other.



COSTLY–No one, especially a banker, likes to see their money fly out the window. Mr. Potter witnessed just such an occasion when he bought his expensive PC from the *other* guys. For all that money, he didn't get applications software, local bus performance or a built-in surge suppressor. The clunker wasn't even upgradable!

The Happy Ending.



Life with ZEOS is near perfection. It's like a great movie–with a happy ending and a lot of really good stuff in-between. Just look at George's story.



SAME-DAY SHIPPING– George was appointed manager of the family-run business. It needed immediate revamping, so he called ZEOS at 800-554-7172 and automated his business with a ZEOS 486 upgradable. Because he ordered one of the more popular configurations and called before 1 pm, ZEOS shipped it right away! No waiting!



24-HOUR SUPPORT– Since George and his staff were new at computers, they had questions –and at all hours. Each time they called the ZEOS 24-hour tech support line, their questions–no matter how basic or complex–were answered by qualified technicians.



TOP PERFORMANCE– Everybody, including George, needs a system that will perform. ZEOS has a proven track record including a trophy case of awards such as *PC Magazine*'s Editors' Choice, *PC World*'s Best Buy and *PC Computing*'s Best Value.



QUALITY & RELIABILITY– George is sitting pretty now. He gets twice as much work done with his new ZEOS 486 local bus upgradable. That's high performance and high quality at work. Which is why George is so happy and ZEOS was awarded *PC Magazine*'s Service & Reliability Award–the only company to win it twice!



COMPATIBILITY– George's staff uses ZEOS computers, but a few of their associates don't–yet. It's important they be compatible with the other systems, which is why he owns ZEOS 486 upgradables–the 100% compatible computers that run all major operating systems.



BEST VALUE– As the business became profitable and the townspeople prospered, so did George. He attributes much of that success to ZEOS systems: "They're top-drawer, top-quality, high-performance systems that you can count on! Feature for feature, they're the best value."

This Is Just A Sample Of What We Can Ship Today.

IT'S AS EASY AS:

1. Choose what ZEOS system package you want. (A sampling of what's available is shown below.)
2. Call ZEOS at 800-554-7172. For same day shipping, place your order before 1 p.m. Central Time, Monday through Friday.
3. Upon credit approval, we'll ship your system *the same day you order!*

OUR GUARANTEE TO YOU:

ORDER BY 1 O'CLOCK GUARANTEED! WE'LL SHIP TODAY

If we accept your order for immediate shipment and fail to ship your system under the conditions outlined, we will ship it *at our expense* as soon as it is ready.*

CALL NOW TOLL FREE
800-554-7172
24 HOURS A DAY

ZEOS® INTERNATIONAL, LTD.



486 SX-25

PACKAGE #2:

- 4MB RAM
- 214MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

$1695



486 DX-33

PACKAGE #2:

- 4MB RAM
- 214MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

$1895



486 DX-33

PACKAGE #3:

- 8MB RAM
- 426MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

$2195



486 DX2-66

PACKAGE #3:

- 8MB RAM
- 426MB local bus hard drive with built-in 128K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

$2495



486 DX2-66

PACKAGE #3 BONUS:

- 8MB RAM
- 256K SRAM system cache
- 528MB local bus IDE hard drive
- Diamond Viper local bus video card
- 15" SVGA color monitor
- Both floppies
- 14,400 bps V.32 bis send/receive fax modem
- DOS, Windows, Mouse
- Choice of Windows application

$2995



486 DX2-66

PACKAGE #4:

- 16MB RAM
- 528MB local bus hard drive with built-in 256K cache
- Windows-accelerated local bus video
- SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

$2995



486 DX2-66

PACKAGE #4 PLUS:

- 16MB RAM
- 528MB local bus hard drive with built-in 256K cache
- Diamond Viper local bus video card
- Vertical case
- 15" SVGA color monitor
- Both floppies
- DOS, Windows, Mouse
- Choice of Windows application

$3334



Ambra™ 486SX-25

PACKAGE #1:

- 4MB RAM
- 107MB hard drive with built-in 32K cache
- Both floppy drives
- SVGA color monitor
- DOS, Windows, Mouse

$1295

*Orders must be for ZEOS *Computers Now!™* configurations; we've listed just a sampling here. Since we continuously update this list of configurations; *please call to confirm your system is on the list.* This offer is good only as long as these pre-built systems remain in stock. Other ZEOS systems and custom configurations take slightly longer—about a week. Credit cards are subject to authorization. Orders must be received by 1 p.m. Central Time, M-F.

Circle 155 on reader service card.

ZEOS® Z-Quote℠



Find out more about the quality, price and performance that have made ZEOS systems famous. It's easy with our Z-Quote form. Simply fill in the quantity and configuration for each product you plan to purchase, then fax this form to ZEOS. We'll get back to you with a price quote, spec sheet or any other information you may need within 24 hours of receipt!

PC'S:

TYPE	# OF UNITS	HARD DRIVE	RAM	MONITOR	FLOPPY DRIVES
EXAMPLE:					
486DX2-66	**3**	**426**	**8MB**	**Color SVGA**	**2**
486SX-25					
486SX-33					
486DX-33					
486DX2-50					
486DX2-66					
486 EISA					

NOTEBOOKS:

TYPE	# OF UNITS	HARD DRIVE	RAM
486SX-33 ColorNote			
386SL-25 Freestyle			
486SL-25 Freestyle			
386SL-25 Contenda			
486SL-25 Contenda			

☐ Extra Battery
☐ Carrying Case
☐ Math Coprocessor
☐ MS DOS
☐ Mouse
☐ Windows
☐ File Transfer Software
☐ other (please specify): _____

ADDITIONAL OPTIONS:

☐ 9600 bps Internal Modem
☐ 2400 bps Internal, 9600 bps Send/Receive Fax Modem
☐ Vertical Case
☐ Tape Backup Type: _____
☐ Multimedia Kit
☐ Video Card Type: _____
☐ Network Card Type: _____
☐ Printer Type: _____
☐ 128K Cache
☐ 256K Cache
☐ On-Site Service _____ yr(s)
☐ Extended Warranty _____ yr(s)
☐ other (please specify): _____

BUYER INFORMATION

Where will computer be located? ☐ home ☐ business office ☐ government agency ☐ educational institution
Have you purchased from ZEOS before? ☐ yes ☐ no
How soon do you plan to buy? ☐ immediately ☐ within 2 weeks ☐ within a month ☐ next 1-3 months ☐ after 3 months
How many employees do you work with? ☐ 25 or less ☐ 26-99 ☐ 100-499 ☐ 500-999 ☐ 1000 or more

If you are considering any other brands of computers, which are they? _____

HOW WOULD YOU LIKE US TO RESPOND? (check all that apply) ☐ Mail ☐ Fax ☐ Phone

Name: _____ Title: _____ Company: _____

Address: _____ City: _____ State: _____ Zip: _____

Phone: (_____) _____ FAX: (_____) _____

FAX TO:
U.S. and Canada:
612-633-9503
U.K.: 0800-960-844
Germany: 0130-817202
France: 05-90-2571

PHONE:
800-554-7172
612-633-6131
612-633-6131
612-633-6131

FAX TO: 612-633-9503

ZQTZ-PCM-9312B

CIRCLE 035 ON READER SERVICE CARD

• Graphics Software

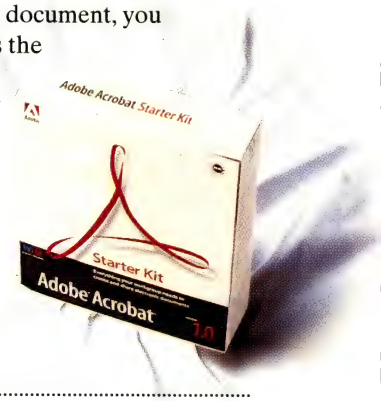
This year's nominees prove that looks are everything and that the PC is the place to create documents, images, and illustrations that pack punch.

WINNER

Adobe Acrobat

BOB WULFF AND THE ACROBAT ENGINEERING TEAM

The age of the portable electronic document has arrived, and Adobe Acrobat is its champion. Thanks to Acrobat, you can now create a highly stylized document in any application you like and know that it can be viewed, with formatting and appearance intact, on any Acrobat-equipped computer—regardless of its operating system, graphics, or font capabilities. To create an Acrobat document, you print from your main application to Acrobat's special printer driver, which creates the necessary PDF (Portable Document File) format file. When you view the PDF, the software checks to see if the fonts included in your document are available on the viewing system; if they're not, it uses Adobe's Multiple Master technology to generate fonts that maintain the look and formatting of your original. All Acrobat files are resolution-independent, so what you create is what they'll see. The package consists of several components: Exchange, which lets you create PDFs; Reader, which lets you view, navigate, and print PDFs; and Distiller, a PostScript interpreter that translates PostScript files into the PDF format. Other products fit into this category, but none pack the power and flexibility of Acrobat.



• *Adobe Systems Inc., 1585 Charleston Rd., Mountain View, CA 94039; 800-833-6687.*

FINALISTS

Adobe Photoshop for Windows, Version 2.5

LAWRENCE COOPET, RALPH GIGGEY, MARK HAMBURG, KEVIN JOHNSTON, JOHN KNOLL, THOMAS KNOLL, PETER MERRILL, SEETHARAMAN NARAYANAN

Adobe Photoshop, the pioneering image editor for the Macintosh, now sets the standard for digital prepress on the PC. It brings to this platform a level of reliability and power that makes working with large, complex images a snap. All the tools an image-editing professional could ask for are here, and they all work just the way they should. The image-enhancement filters are flawless, the selection tools precise, and the color handling and separation capabilities impeccable. Add in 8-bit alpha channel-masking technology, the ability to manipulate images directly in CMYK color space, and a full-blown PostScript interpreter that lets you create vector-based outlines with a precision you would expect to find only in an object-oriented illustration package. You can see the power behind the beauty.

• *Adobe Systems Inc., 1585 Charleston Rd., Mountain View, CA 94039; 800-833-6687.*

Visio, Version 2.0

PETER C. MULLEN, RICHARD MIYAUCHI, LORI D. PEARCE, D. MITCHELL BOSS, DAVID D. WALTER, MARK E. DAVISON, TED JOHNSON

With Shapeware's Visio, even if you can't draw a straight line you can create a professional-looking diagram or business illustration. Instead of forcing you to draw shapes to liven up your business reports or presentations, Visio lets you simply drag them off an electronic stencil and drop them onto your page. Each of the stencils contains a series of task-specific SmartShapes—objects with style and behavior attributes already attached to them. You can modify any objects you place on the page, or even make changes to the master stencil object to effect global changes in a drawing. And for the graphically courageous, there's even a streamlined set of drawing tools.

Version 1.0 introduced the basic concepts, but this second version really makes them shine. The package is even more powerful and easy to use now, thanks to a refined interface, extensive support for OLE 2.0, and even smarter SmartShapes.

• *Shapeware Corp., 1601 Fifth Ave., Seattle, WA 98101; 800-446-3335.*

In the dog-eat-dog world of business presentations, we just made you a pit bull with the legs of a greyhound.

In dog racing as in business, if you're not leading the pack, the view seldom changes. Meet your new leg up on the competition: the Tektronix Phaser™ 200 color printer. It's lean, mean, and very very fast. Of course, you don't have to take our word for it, *PC Computing* magazine just called it the best overall presentation printer in the business. So much for the other guys.



But what is it that makes the Phaser 200 so good? For starters, the ink coverage and image quality are, in a word, brilliant. We at Tektronix didn't get to be the award-winning leader in color printers by sitting on our hands. Then there's speed. You get all of this great color at two pages per minute, which is nearly as fast as a regular black and white printer. Can you say increased productivity?

On top of all this, the Phaser 200 is a work group printer that gives you the advantages of a laser printer. Including true Adobe® PostScript™ Level 2, networkability, separate paper and transparency trays and price (did we happen to mention the Phaser 200 has a list price of only $3,695?).

For more information or a free output sample, come into your nearest Tektronix dealer or call us at 800/835-6100, Dept. 31E. For faxed information, call 503/682-7450, and ask for document # 5001.

In closing, we just want to remind you that your competition is also reading this ad. And they're extremely hungry. So when choosing a presentation printer, the choice is quite simple. You can either eat, or be eaten. Bon appétit. **Tektronix**

Phaser is a trademark of Tektronix, Inc. PostScript is a trademark of Adobe Systems, Inc. All other marks are trademarks or registered trademarks of their respective companies.
CIRCLE 001 ON READER SERVICE CARD

RUNNING WIND
NORTON DESKTOP
SWIM AFTER
AND THEN R
THE POOL WITH



Listen up, you risk-takers. What would your mother say if she saw you now?

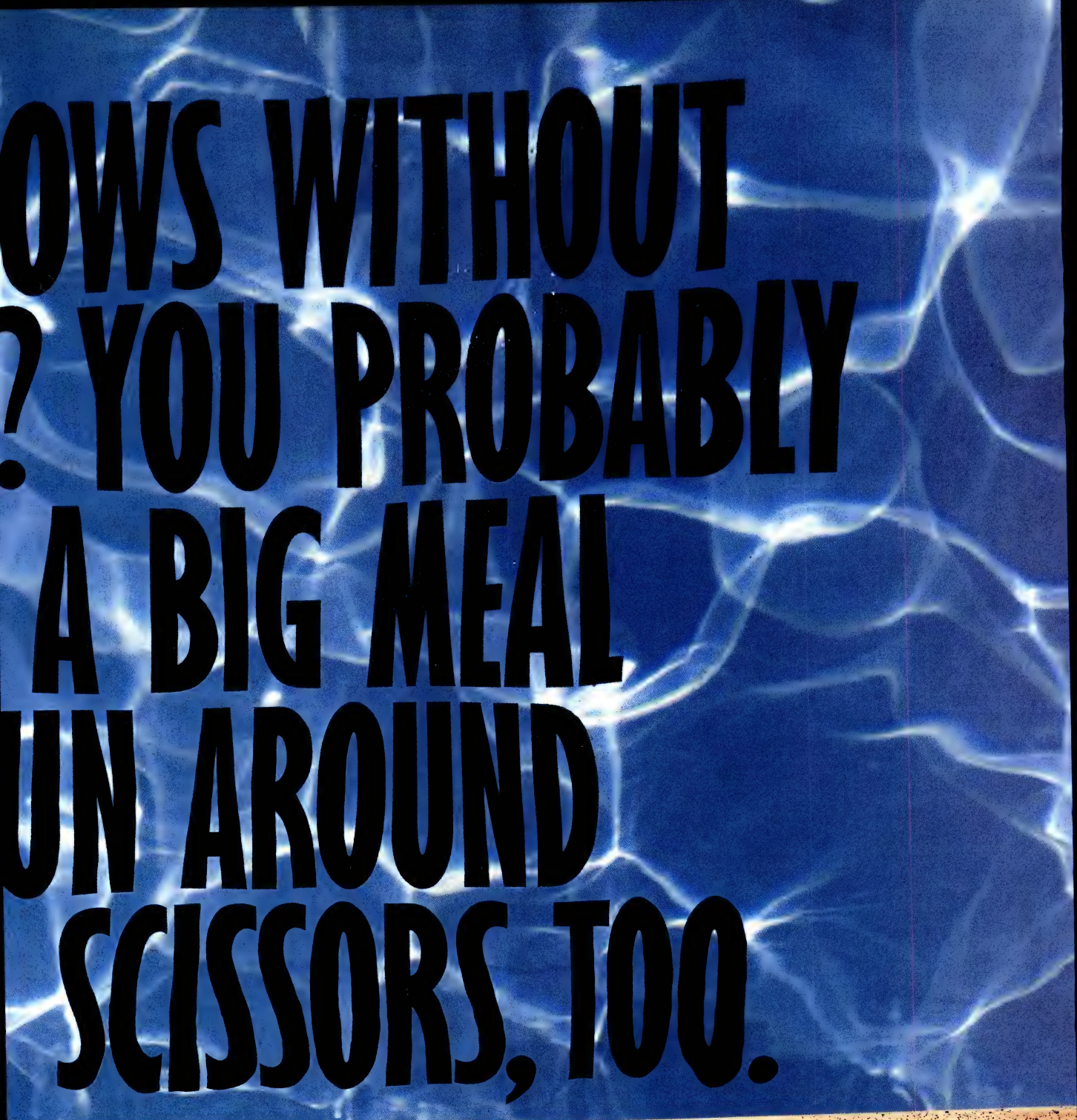
No doubt she would tell you to get the new Norton Desktop 3.0 for Windows before you hurt yourself. Or your computer.

That's because NDW 3.0 not only enhances your work, it's also the safest way to run Windows short of tapping into Bill Gates' subconscious.

Made by Peter Norton, it's packed full of utilities to provide a safer working environment.

Like our new Norton AntiVirus 3.0, which protects your system against over 2,300 known viruses, and our new Norton BackUp™ 3.0 with enhanced support for SCSI drives. There's also the new UnErase, to recover accidentally erased files. Disk Doctor for automatic disk diagnosis and repair. And a Fix-It disk with a full collection of DOS utilities to recover and repair files or entire disks, even if you can't run Windows. And now

For information in Europe, call 31-71-353111. Australia, 61-2-879-6577. Canada, 1-800-667-8661. Elsewhere outside U.S., 408-252-3570. The Norton AntiVirus and Norton Disk



for the first time you'll be able to run Speed Disk under Windows to boost performance.

In addition, NDW 3.0 simplifies Windows for you by integrating file and program management. And while the new FileAssist will allow you to easily manage your files without having to leave your applications, the new Day Planner will allow you to easily manage your life.

Plus, the new "push button" Control Center lets you customize pull-down menus, icons, toolbars and more to make Windows look and work the way you want it to.

So the choice is yours. Either see your local dealer, call 1-800-628-4777, ext. BG85 to order, or live a life of danger and recklessness, running Windows without Norton Desktop 3.0 for Windows and sprinting around pools with sharp objects until you put somebody's eye out.

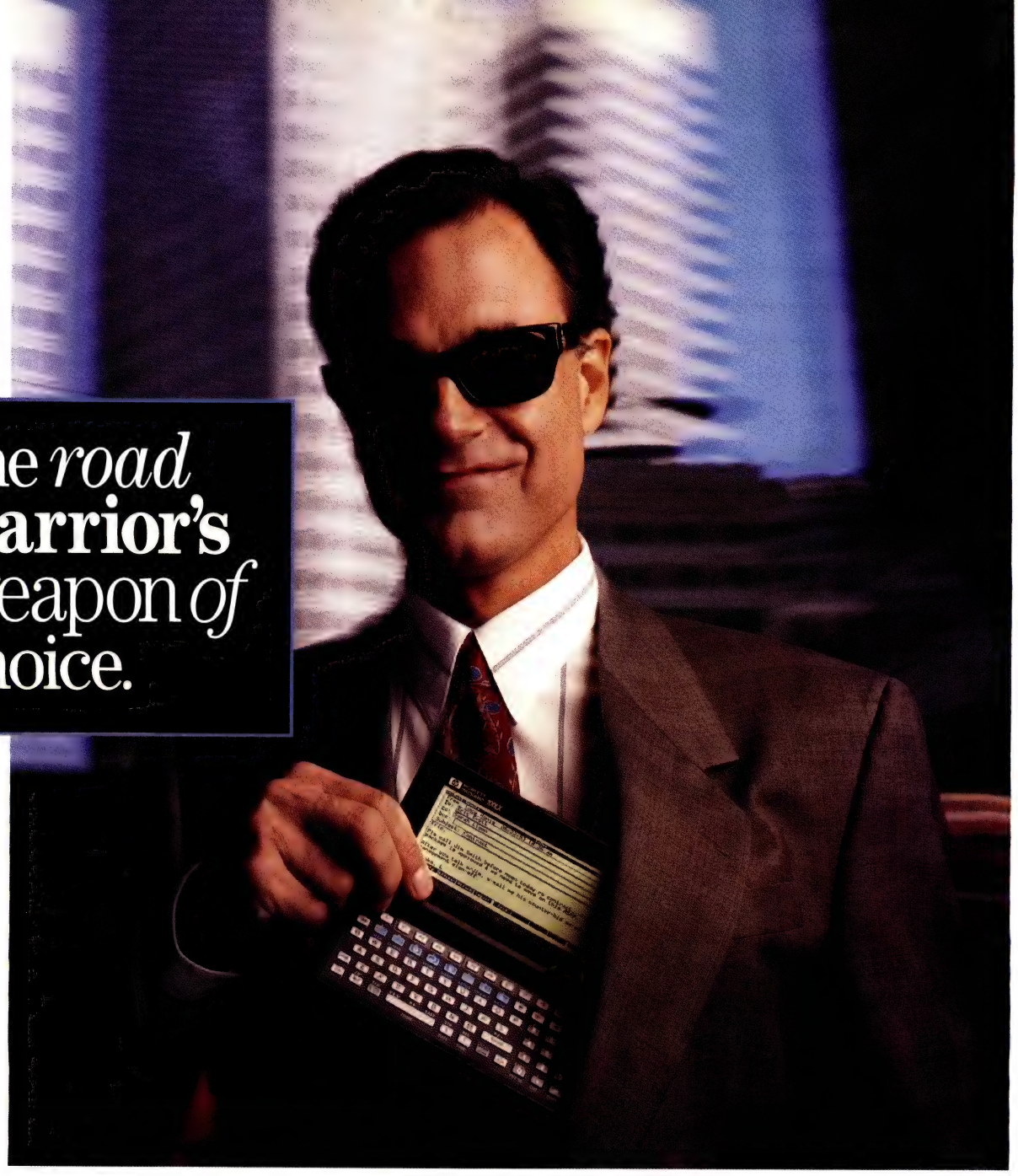
Of course, you would be absolutely crazy not to get NDW 3.0. And remember, don't run Windows without it!

THE NORTON DESKTOP™ FOR WINDOWS

SYMANTEC.™

Doctor are registered trademarks and Norton BackUp, Norton Desktop and Speed Disk are trademarks of Symantec Corporation. ©1993 Symantec Corporation. All rights reserved.

CIRCLE 117 ON READER SERVICE CARD



The *road* **warrior's** weapon *of* choice.

The HP 100LX palmtop PC keeps you in touch wherever you go.

It packs cutting-edge computing and communications features. All wrapped up in a sleek 11-ounce package. Including one-key access to:

cc: Mail® Mobile, the market-leading e-mail software. Today's new card modems fit neatly into our PCMCIA 2.0 slot, connecting you to your corporate or office e-mail systems. Talk about portable communications! This e-mail solution fits right in your pocket.

Take most of your office with you. Built-in MS-DOS® 5.0 means you can run optional PC software, such as Quicken, Microsoft® Project Manager and ACT! No other palmtop comes close.

With equal ease, you can create custom databases. And sort through a list of customer billing profiles or your favorite restaurants.

Even when you're on top of the world, our appointment book keeps you on top of your schedule. With week- and month-at-a-glance. You don't miss a thing.

123 Keep running numbers on the run. One touch brings up Lotus® 1-2-3,® Rel. 2.4. You're in spreadsheet heaven!

The features keep coming. Like notetaker to capture ideas. Powerful analysis on the HP financial calculator. Flexible phone book. And much, much more.

For more information and the name of your nearest HP 100LX dealer, call us at 1-800-443-1254, Dept. 896. Or in Canada, 1-800-387-3867. Then hit the road armed with all the right answers.

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• Operating Systems & Software Standards

More than ever, programmers look to operating-system features for help with application development and integration. These advanced standards and products offer solid solutions.

WINNER

Microsoft OLE 2.0

TONY WILLIAMS, RAO REMALA, CRAIG WITTENBERG, BOB ATKINSON, SRINI KOPPOLU, DOUGLAS HODGES, MARK LUCOVSKY



Although boundaries between applications have long been disappearing, APIs and software standards such as Dynamic Data Exchange (DDE) and Object Linking and Embedding (OLE) offer much tighter integration than a common GUI clipboard or third-party integration tools. Here OLE stands out because it lets users build compound documents—ones composed of sections that were created and that can be edited with a variety of software tools.

The first implementations of OLE worked, but they were awkward because they launched new applications in new windows. The latest version, OLE 2.0, addresses past limitations and offers developers a new set of integration features. The most obvious change is OLE 2.0's ability to let application resources be used for editing inside other OLE 2.0–aware applications. Developers can also drag portions of documents from one application and drop them into another. OLE automation lets one application control or be controlled by other applications. Earlier in 1993, Microsoft shipped OLE 2.0 as an SDK. Since then, we've seen the first few successful OLE 2.0 applications, which include Microsoft Publisher and Shapeware's Visio. Creating an OLE 2.0 app is still difficult: The API is complex, libraries are in flux, and advanced tools to help the process are still missing. But OLE 2.0 is a substantially better method of integration and will fundamentally change what we expect from software.

• *Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-227-4679.*

FINALISTS

Microsoft Windows NT

DAVE CUTLER, MOSHE DUNIE, MARK CLIGGETT, LOU PERAZZOLI, LEIF PEDERSON, DAVE THOMPSON, KEN GREGG

An industrial-strength operating system designed to bring workstation-level performance and features to the desktop and server, Windows NT is Microsoft's next-generation OS. Of course, it's 32-bit, multitasking, multithreaded, and graphical; lots of advanced operating systems can say that. But Windows NT has features we haven't seen in operating systems built for mainstream PCs, such as C2-level security and multiprocessor support. While it demands a substantial hardware platform, from there it takes off, making use of multiple megabytes of memory and multiple processors. Windows NT also boasts portability to many different CPU architectures, including Intel's *x*86 family, DEC Alpha, and MIPS R4000/R4400, with more to come. It's a system designed for high-end applications, and it portends PC operating systems to come.

• *Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-227-4679.*

NeXTStep 3.1 for Intel Processors

THE NEXTSTEP DEVELOPMENT TEAM

The best harbinger of future operating systems may well be NeXTStep, the Unix-derived operating system that NeXT finally delivered on the Intel platform this year. In addition to the usual high-end OS features—like all its competitors, it is a 32-bit, multitasking, multithreaded, graphical OS—NeXTStep goes farther. It offers a truly object-oriented user interface, a unified imaging model based on Adobe's Display PostScript, and support for 24-bit color. It shows its true strength as a development platform, used in conjunction with the NeXTStep Developer, a series of object-oriented development tools. If NeXTStep manages to garner widespread device and developer support, this will be an OS for all the competition to watch.

• *NeXT Inc., 900 Chesapeake Dr., Redwood City, CA 94063; 800-848-6398.*

A

is for **A**ttention, please! **A**ll you people who want the latest technology at **A**mazingly **A**ffordable prices! Meet **A**MBRA:™ a new and fast-on-its-feet computer company.

M

means we're **M**aking our **M**ove. With high-performance **M**ade-to-order AMBRA **M**achines. All are tested for industry-standard compatibility, and come with a 30-day **M**oney-back guarantee.[1]

B

is for **B**ig advantages—like **B**lazing-fast Intel® Pentium™ processors. It's about **B**uilt-in extras—like added cache and VESA local **B**us. Across the **B**oard, we're talking **B**est value here.

R

is for **R**esponsive to your needs, and **R**eady to deliver to your door. It's for **R**apid onsite service.[1] Plus **R**ound-the-clock technical support. The kind you can **R**eally **R**ely upon.

A

stands for "Just **A**sk us." **A**MBRA has intelligent **A**nswers to **A**ll your questions and computing needs. Call 1-800-25-**AMBRA**.

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A COMPETITIVE NEW COMPANY, AMBRA'S COMING ON STRONG...

Grounded in excellence, AMBRA has an unmistakably entrepreneurial edge. Through worldwide sourcing, we get the latest and leading technology from high-quality suppliers at smart prices. And we immediately *run* with it — passing our *savings* along to you.

WE BUILD ON THE SPOT, TO YOUR SPECS...

With AMBRA, you have your pick of processors — from the most affordable 486s, to full-fledged 64-bit Intel Pentium technology. You also have your choice of memory sizes, hard disks, video subsystems, peripherals and software — preinstalled and preloaded with no delay and *no service fee.*

AND OFFER SOLUTIONS THAT MATCH YOUR NEEDS.

Space-saving slimlines.
Fast-action, low-cost 486 AMBRA slimlines pack the computing power you need — perfect for the office, dorm or home.

Desktops and minitowers.
Our ISA and EISA-based systems offer a range of power — and a direct path to Pentium technology — at prices that won't make you pause.

Powerhouses with Pentium processors.
You get the latest in true 64-bit processing power — with processing speeds surpassing 100 MIPS!

AT AMBRA, YOUR BUCKS BUY A LOT MORE...

Like built-in cache, accelerated video, VESA local bus, and a wealth of other features that raise the value of our computers above the rest. You'll find there's nothing "low-down" about an AMBRA, except the price.

INCLUDING RAPID SERVICE AND ROUND-THE-CLOCK SUPPORT.

Every AMBRA computer comes with a 30-day "satisfaction or your money back" guarantee. We've contracted with IBM® to provide a one-year onsite warranty.[1,2] Expert technicians are poised to deliver prompt onsite service Monday through Saturday. And you can count on toll-free technical support 24 hours a day, 7 days a week.

ALL YOU HAVE TO DO IS CALL.

Just pick up the phone to get more information or place an order. AMBRA's lines are open every weekday 8 am to 9 pm, and Saturday 10 am to 6 pm (ET.) We accept American Express,® Visa® and MasterCard® — as well as purchase orders from qualifying businesses.

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Purchase any AMBRA slimline, desktop or tower, and you get a CD-ROM disk[3] encrypted with over 80 popular software packages, thanks to special new technology. Try each package up to three times at your convenience. Then, whatever you like can be yours with just a call — at a very competitive price! There's no waiting for delivery — you get a code to unlock the encryption, and simply download your software purchases from the CD to your hard disk.

AMBRA™
COMPUTER CORPORATION

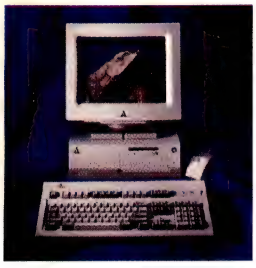
JUST SIX OF MANY AMBRA MODELS...



Slimline S425SX

- 486SX, 25 MHz
- Upgradeable to Pentium technology
- 4MB RAM, max: 36MB
- 128KB processor cache
- 3.5" 1.44MB diskette drive
- 170MB (17ms) hard disk
- 3 storage bays
- 3 16-bit ISA slots (2 VESA on local bus)
- Windows accelerator w/ 1MB video memory
- 14" SVGA LR color monitor
- Slimline casing (3 x 3)
- MS-DOS® 6.0, Windows™ 3.1, mouse

$1,339



Slimline S450DX

- 486DX2, 50 MHz
- Upgradeable to Pentium technology
- 4MB RAM, max: 36MB
- 128KB processor cache
- 3.5" 1.44MB diskette drive
- 240MB (15ms) hard disk
- 3 16-bit ISA slots (2 VESA on local bus)
- 3 storage bays
- Windows accelerator with 1MB video memory
- 14" SVGA LR color monitor
- Slimline casing (3 x 3)
- MS-DOS 6.0, Windows 3.1, mouse

$1,815



Desktop D466E/VL

- 486DX2, 66 MHz
- Upgradeable to true 64-bit Pentium technology
- 8MB RAM, max: 64MB
- 256KB processor cache
- 3.5" 1.44MB diskette drive
- 440MB (12ms) hard disk
- 8 32-bit EISA slots (2 VESA on local bus)
- 6 storage bays
- S3 video accelerator with 1MB DRAM
- 15" Flat Square LR color monitor, NI
- Desktop casing (8 x 6; convertible to minitower)
- MS-DOS 6.0, Windows 3.1, mouse

$2,959



Minitower T466DX

- 486DX2, 66 MHz
- Upgradeable to Pentium technology
- 8MB RAM, max: 64MB
- 256KB processor cache
- 3.5" 1.44MB diskette drive
- 340MB (12ms) hard disk
- Onboard SCSI
- 8 16-bit ISA slots (2 VESA on local bus)
- 6 storage bays
- Windows accelerator with 1MB video memory
- CD-ROM drive
- 14" SVGA LR color monitor
- Network-ready (Ethernet 10BaseT)
- Minitower casing (8 x 6)
- MS-DOS 6.0, Windows 3.1, mouse

$2,694



Pentium DP60E/VL

- Intel Pentium processor, 60 MHz
- 64-bit processor complex
- 8MB RAM, max: 64MB
- 256KB processor cache
- 3.5" 1.44MB diskette drive
- 540MB SCSI hard disk
- Onboard dual-channel Fast SCSI-2
- 8 32-bit EISA slots (2 VESA on local bus)
- 6 storage bays
- ATI® Ultra Pro™ Mach 32, 2MB VRAM
- 14" SVGA LR color monitor
- Desktop casing (8 x 6; convertible to minitower)
- 200-watt autoswitching power supply
- MS-DOS 6.0, Windows 3.1, mouse

$3,999



Notebook NC425SL

- 486SX, 25 MHz, SL-Enhanced
- Dual-scan STN color screen
- Integrated fax/modem
- 4MB RAM
- 120MB hard disk
- Integrated trackball
- MS-DOS, Windows, MS-Works™

$2,449

intel inside

In Canada,[4] call 1-800-363-0066, Ext. 910

CALL 1-800-252-6272, EXT. 334

1-800-25-AMBRA

[1] Please call 1-800-252-6272 for details regarding AMBRA's money-back guarantee and limited warranty. One-year onsite service at no additional charge during warranty. Onsite service may not be available in certain locations.
[2] Return shipping and insurance charges are the responsibility of the customer. [3] CD-ROM drive required; may be purchased with system or separately. [4] Offerings may differ in Canada.

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• Development Tools

Developing applications for the Microsoft Windows environment is a whole new game. Whether you're writing code or chasing bugs, this year's crop of tools makes it easier to play.

WINNER

WinScope, Version 1.1

BRETT SALTER, CHRIS SCHWARTZ, JIM MISCHEL



Working in Microsoft Windows has made the lives of end users much easier, to be sure. But what about the harried programmers who have to build and debug those Windows applications? There's a world of difference between tracking down bugs in a traditional procedural app and doing the same thing in the less-predictable, event-driven Windows environment. Enter WinScope, from The Periscope Company. Unlike traditional debuggers, this indispensable programming tool lets you monitor all types of Windows events by capturing the actual API calls an application makes. This puts WinScope in a different class from other event-capture tools, which merely let you snoop on messages a Windows application passes to the operating environment. WinScope understands and can capture over 1,200 API calls—including some 200 undocumented calls—and hundreds of Windows messages. It can even monitor the execution of existing programs, offering fascinating insight into how they work. You can also set up to 16 breakpoints that can trigger an external debugger when specific events occur. The result: a package that can give you a better view into your Windows code—and other peoples' applications—than any tool we've seen.

• *The Periscope Co., 1475 Peachtree St., #100, Atlanta, GA 30309; 404-888-5335.*

FINALISTS

Bounds-Checker for Windows, Version 2.0

FRANK GROSSMAN, JIM MOSKUN, DOM BASILE, MATT PIETREK, BILL WONG

Programmers are always looking for new and better ways to exterminate the bugs in their code. Nu-Mega Technologies' Bounds-Checker for Windows finds the tricky ones. Its event-logging and viewing capabilities show you exactly which events in your program led up to a glitch. You can verify your program's use of C-library functions that relate to string and memory manipulation, check all API call parameters, and track the allocation of memory and resources. If you hit a divide-by-zero error or a general protection fault, Bounds-Checker can show you the instruction that caused the problem. In short, it combines the features of a heap checker, debug kernel, and postmortem tool. Bounds-Checker will help you make your programs as bug-free as possible—and spend less time doing so.

• *Nu-Mega Technologies Inc., P.O. Box 7780, Nashua, NH 03060-7780; 603-889-2386.*

Microsoft Visual C++, Version 1.1
Microsoft Visual C++ 32-Bit Edition, Version 1.1

THE VISUAL C++ DEVELOPMENT TEAM

With Visual C++, Microsoft successfully redefines how C and C++ developers create Windows applications. This development environment's most significant advances, AppWizard and ClassWizard, let a programmer interactively generate a complete, working framework—essentially a functioning skeleton application—for jump-starting programming projects. A new version of the Microsoft Foundation Class (MFC) Library is used for all code generation. Among its many enhancements, MFC 2.0 adds support for Visual Basic custom controls, letting C++ programmers take advantage of a vast third-party market of prewritten functionality. The new resource editor, AppStudio, is entirely visual and lets programmers launch the ClassWizard from within it to bind interface objects to code. Visual C++'s seamless integration of these powerful productivity enhancers has other compiler vendors scrambling to keep up.

• *Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-227-4679.*

After Hours

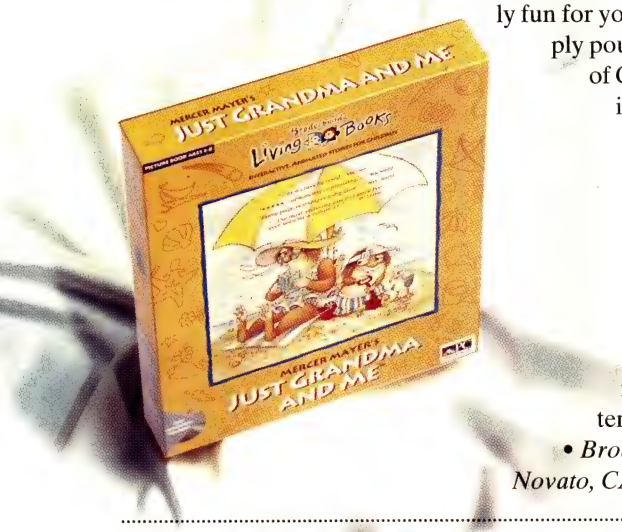
Sights, sound, and lots of action—this year's playful and educational winners combine the best of the new multimedia technologies with good old-fashioned imagination.

WINNER

Broderbund's Living Books

THE LIVING BOOKS DEVELOPMENT TEAM

Talk about electronic books is cheap, but Broderbund's Just Grandma and Me, the initial title in its Living Books series, is the first one that really does the concept justice. A CD-ROM version of Mercer Mayer's delightful children's story, this product (designed for kids three to eight years old) is actually fun for youngsters of all ages. More than just words and pictures simply poured into a CD, this program lets children explore the world of Grandma and Little Critter as they make their way to an outing at the beach. Clicking almost anywhere on the screen triggers an animated or musical reward.



Just Grandma and Me is as easy to use as a real book, but it employs computer multimedia technology to add great value. You can have the story read to you in English, Japanese, or Spanish, or you can explore the story on your own.

The company has followed suit with other excellent programs, including Arthur's Teacher Trouble, but Just Grandma and Me has set a new high standard for multimedia content, giving form and meaning to the term "interactive book."

• *Broderbund Software Inc., 500 Redwood Blvd., P.O. Box 6121, Novato, CA 94948-6121; 415-382-4400.*

FINALISTS

Design and Build Your Deck

STUART GANNES, DAN LEVIN, JIM ROSENAU, MATTHEW SELF

How can an electronic book improve on its printed counterpart? Take a look at Design and Build Your Deck, the first in The House and Yard Series, and count the ways.

A two-part program from Books That Work, Design and Build Your Deck begins with a multimedia how-to segment that walks you through all the steps you need to construct a deck. Animated movies, sound, and hypertext-linked tutorials teach you everything from using your tools to building railings. The second part is a design workshop where, after viewing various deck designs, you can work with a mini CAD program to design your dream deck. It even delivers a custom bill of materials to take to the lumberyard. A tool that helps you through the job from start to finish, Design and Build Your Deck is a sample of information-based packages to come.

• *Books That Work, 285 Hamilton, #260, Palo Alto, CA 94301; 415-326-4280.*

Kid CAD

JOHN SOSOKA, MARK LOPARCO, AND THE KID CAD DEVELOPMENT TEAM

Move over, Lincoln Logs—building blocks have met the electronic age. With some pretty sophisticated CAD-like tools housed in a very simple interface, Davidson & Associates' Kid CAD lets children easily create all sorts of three-dimensional buildings. Viewing options let half-pint architects see their creations from different angles and zoom in or out. Kids can then paint their houses and add furniture, shrubbery, and people. Even cleaning up is an innovation: Demolition tools include a variety of creative bombs and bulldozers. A cross between SimCity and AutoCAD, and aimed at children eight years and older, Kid CAD appeals to the builder in all of us.

• *Davidson & Associates Inc., 19840 Pioneer Ave., Torrance, CA 90503; 310-793-0600.*

The BJC-600 Color Printer In Black And White.

At Canon®, we think that before you go out and buy a personal color printer for your home or small office, you should have all the facts in black and white. And have them right in front of you.

So, let's start with the quality of our print.



The new Canon BJC-600 prints 360 dpi for both brilliant color and crisp black and white output on plain paper. Other color printers print a mere 300 dpi.

We also use inks that are richer and more vibrant. And to eliminate cross-color bleeding on plain paper, our inks have been made to dry much faster than conventional inks.

Now, what's the graphics print-out speed like?

Faster than you'd expect from a personal color printer. That's because the new BJC-600 print head has 192 color nozzles, compared to as few as 48 on other personal color printers. And to further help speed it along, the BJC-600 is designed to print color in both directions across the entire page.



Okay, how about all the little hidden costs?

Not here. The cost-per-page of the BJC-600 is a fraction of what you would normally pay for color printing.

Unlike most other color printers, the BJC-600 has 4 separate ink cartridges — one for each color. So when you run out of one color you don't have to replace all the others.

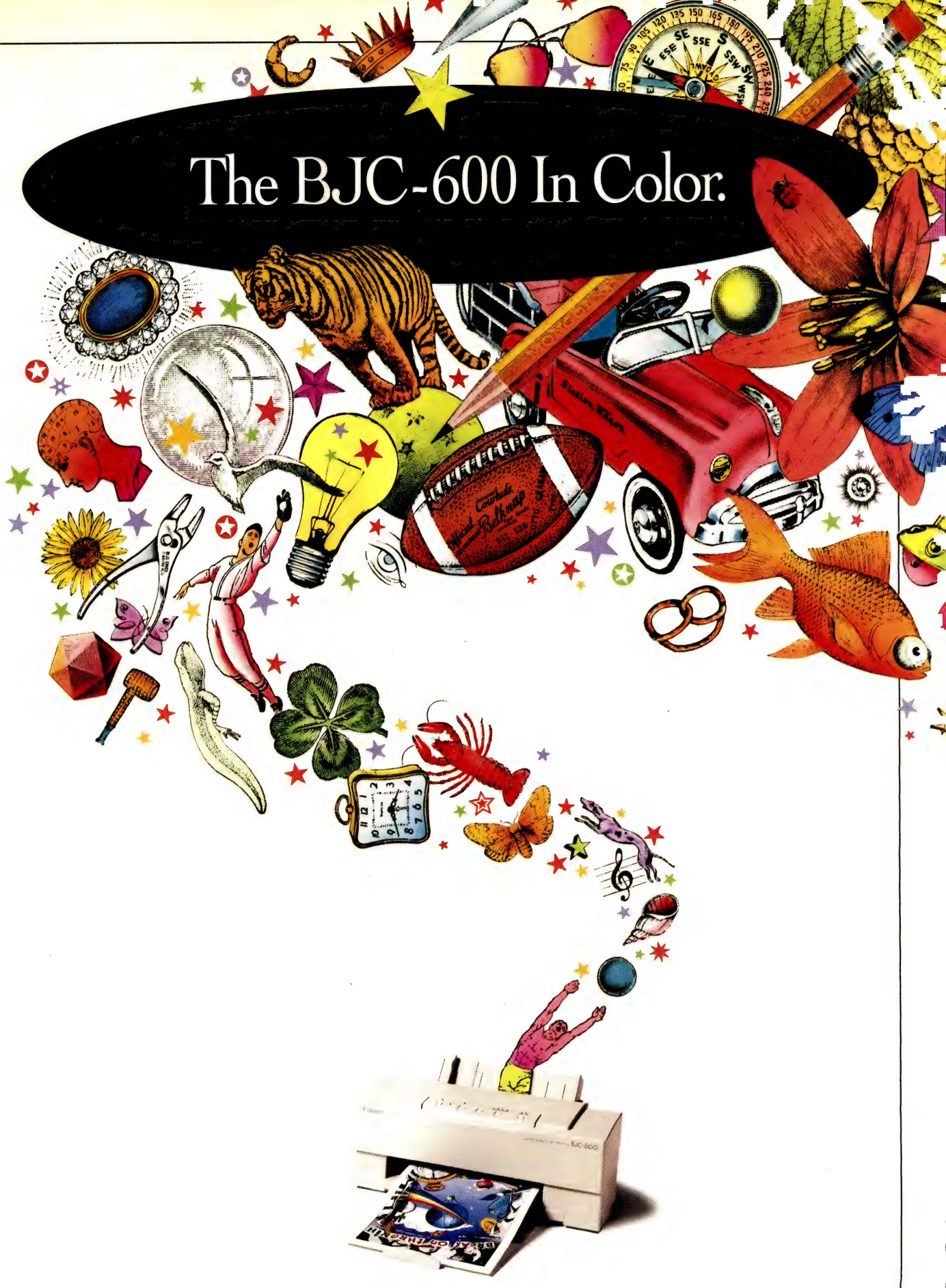
Finally, at less than $649*, the Canon BJC-600 color printer will save you money right from the start.

To get the name of your nearest Canon dealer, call 1-800-848-4123. Because now that you know the facts in black and white, it's time to see the BJC-600 in color.

Canon

*Dealer prices may vary, but most dealers sell the BJC-600 at prices under $649. © Canon Computer Systems, Inc. Canon and BJ are registered trademarks, and Bubble Jet is a trademark of Canon Inc. CCSI 2995 Redhill Ave., Costa Mesa, CA 92626. In Canada, call (800) 387-1241.

The BJC-600 In Color.



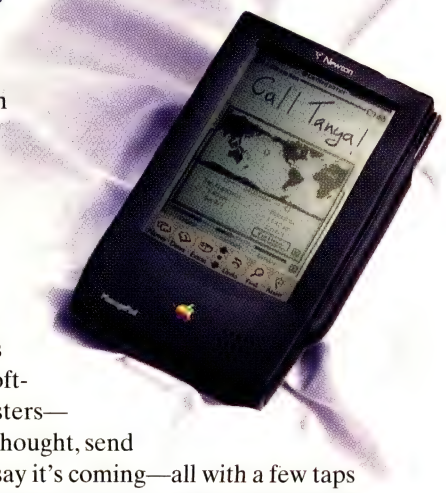
• Design

Which is mightier, the pen or the mouse? From path-breaking new concepts to subtle tweaks on existing technology, new input devices led the design field in 1993.

WINNER

Apple Newton MessagePad

THE NEWTON MESSAGEPAD DEVELOPMENT TEAM



Without a doubt, the most controversial item in this year's Technical Excellence discussions was Apple's Newton MessagePad. A strong faction of our editors felt that the Newton, which is the first Apple product based on Newton Intelligence technology, was little more than a status toy to brandish at Silicon Valley cocktail parties. Others—a majority of others—saw the Newton PDA as a harbinger of computing's future.

While the Newton's trainable handwriting recognition has been the butt of jokes, it represents an extraordinary accomplishment, given the hardware constraints of the PDA format. And handwriting recognition is only a piece of the equation. Newton Intelligence (Apple's name for the software and silicon behind the Newton) lets the product learn about its masters—both their handwriting and the types of tasks they do. You can jot down a thought, send it off as a fax, record the event on your calendar, and call the recipient to say it's coming—all with a few taps of the pen. It's this vision of sophisticated hardware and software integration in a highly portable format that we salute. Whether you find the Newton a truly impressive piece of work or just a faint hint of things to come, you have to agree: The Newton is a sleek milestone on the road to a new kind of computing.

• *Apple Computer Inc., 20525 Mariani Ave., Cupertino, CA 95014; 800-776-2333.*

FINALISTS

Microsoft Mouse, Version 2.0

STEVE KANEKO, CLIFF BROOKS, DICK LIU, KEN ROBERTSON

If you thought the mouse had reached an evolutionary dead end, think again. The new Microsoft Mouse may look like a lopsided bar of soap, but its excellent tactile feel sums up two years of testing and research. Whether you're right-handed or a southpaw, the new shape and larger buttons will match the contours of your palm and fingers to perfection. By adding an optical component to the encoder mechanism, Microsoft has also improved control.

The slick new Version 9.0 mouse driver is an integral part of the package. Its many useful features include automatic cursor snapping to default buttons in Windows dialogs, and the ability to wrap the cursor from one side of your monitor to the other. In the world of mice, it's the little things that count. Microsoft has not taken one little thing for granted in this thoughtful design.

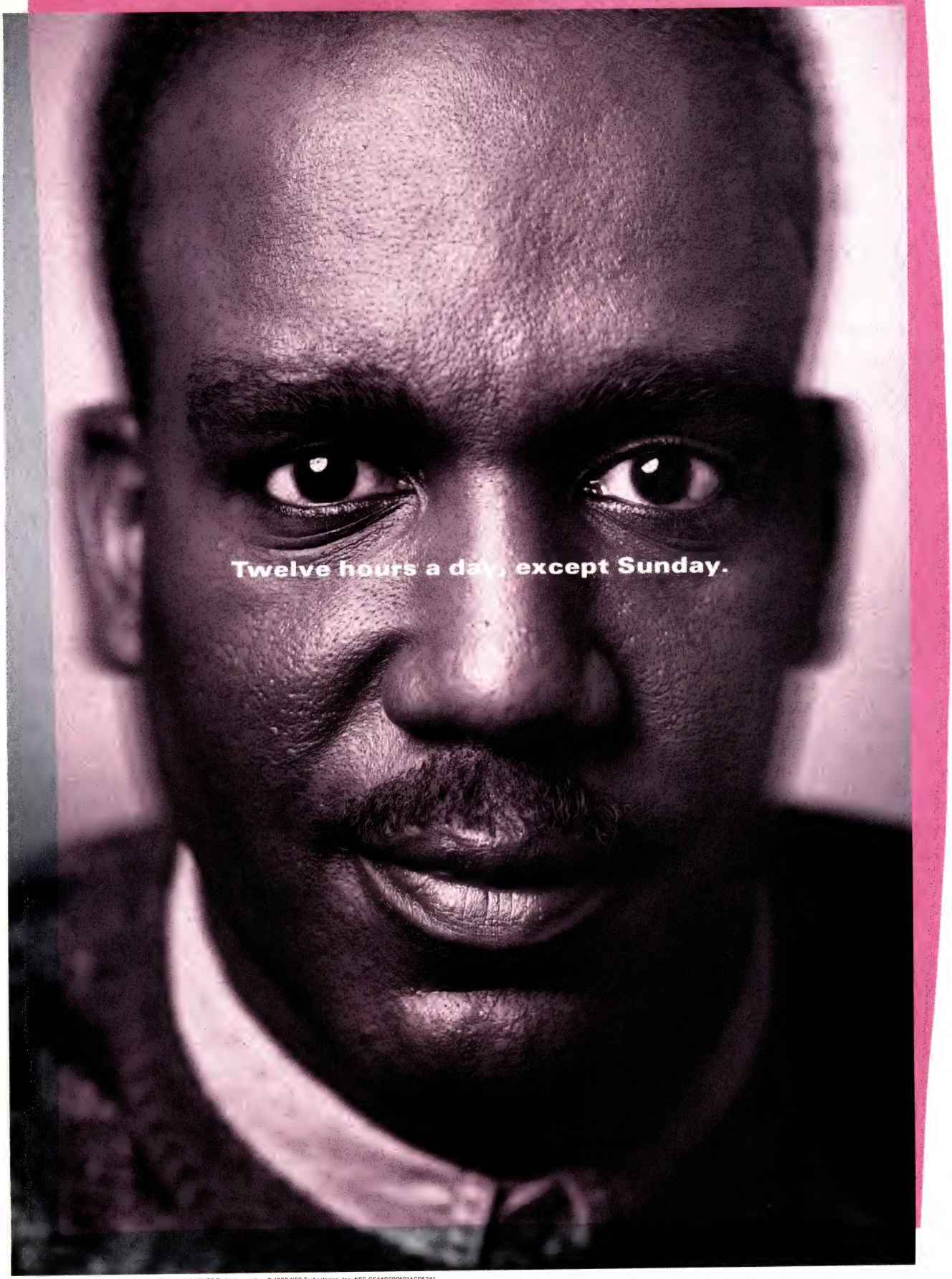
• *Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-227-4679.*

IBM TrackPoint II

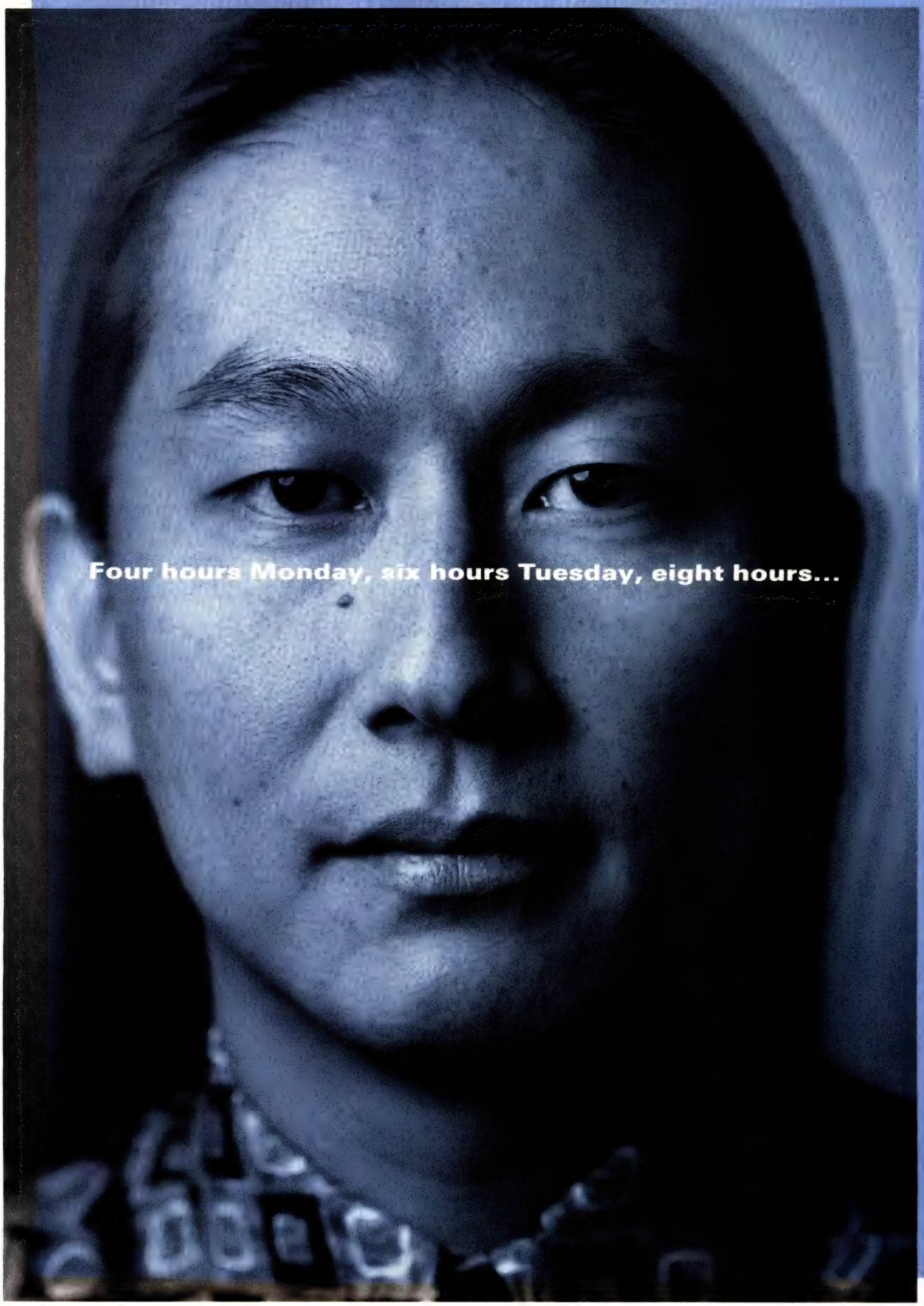
TED SELKER AND THE TRACKPOINT II DEVELOPMENT TEAM

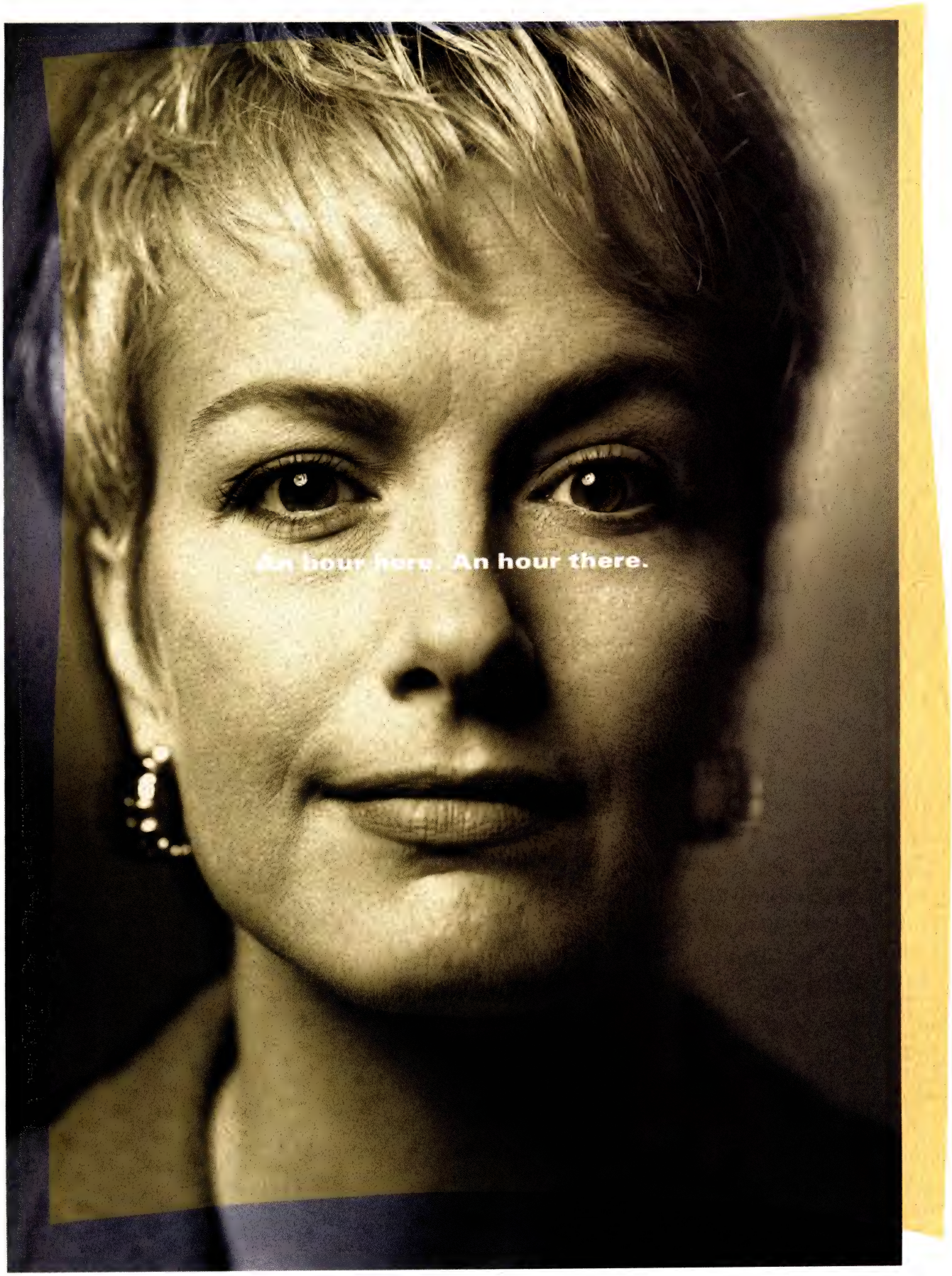
Who would have thought that something resembling a red pencil eraser would become the ultimate portable pointing device? We think the IBM TrackPoint II— that small red dot that's become the hallmark of the IBM ThinkPad line—is nothing less. The TrackPoint sits unobtrusively between the G and H keys of the keyboard, letting you keep both hands in typing position. Strain-gauge technology and sophisticated software algorithms provide omnidirectional cursor motion and let you accelerate the cursor by pressing harder. The result is great control without the bulk or inconvenience of a separate mouse. You can't lose the TrackPoint, shut the lid on it, or break it off with your elbow. Clearly, this is a mouse of a different color.

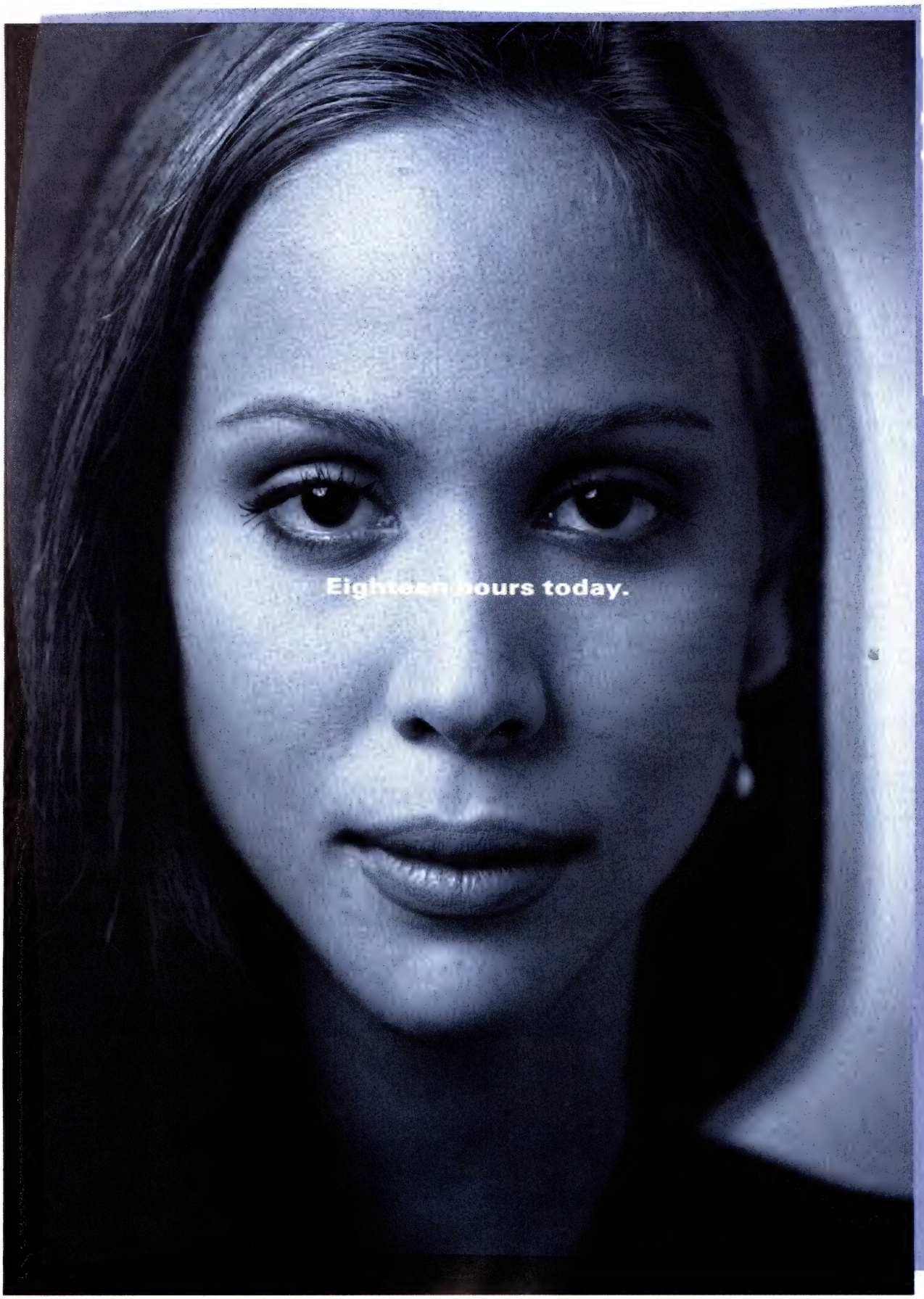
• *IBM Personal Computer Co., Route 100, Somers, NY 10589; 800-772-2227.*

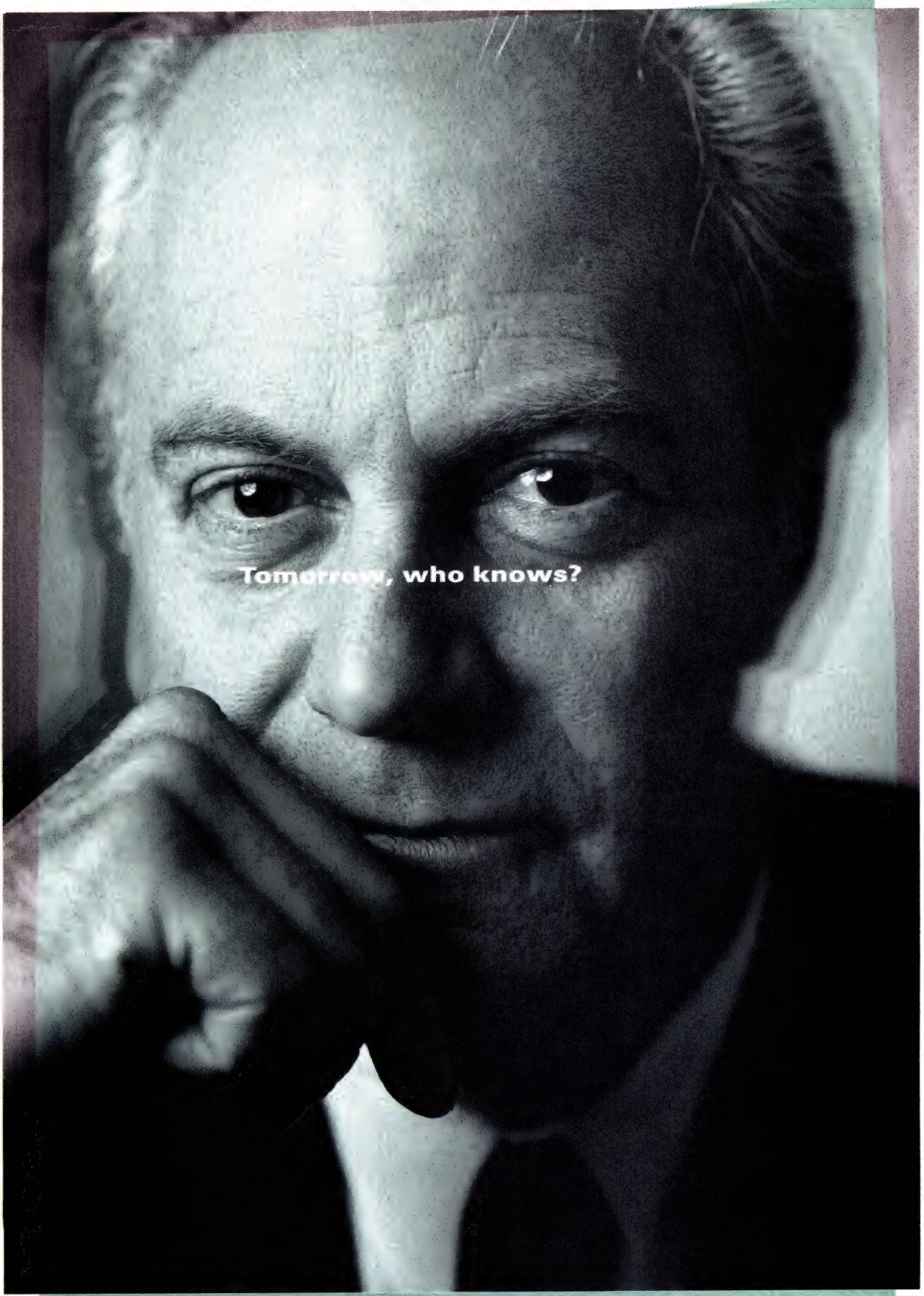


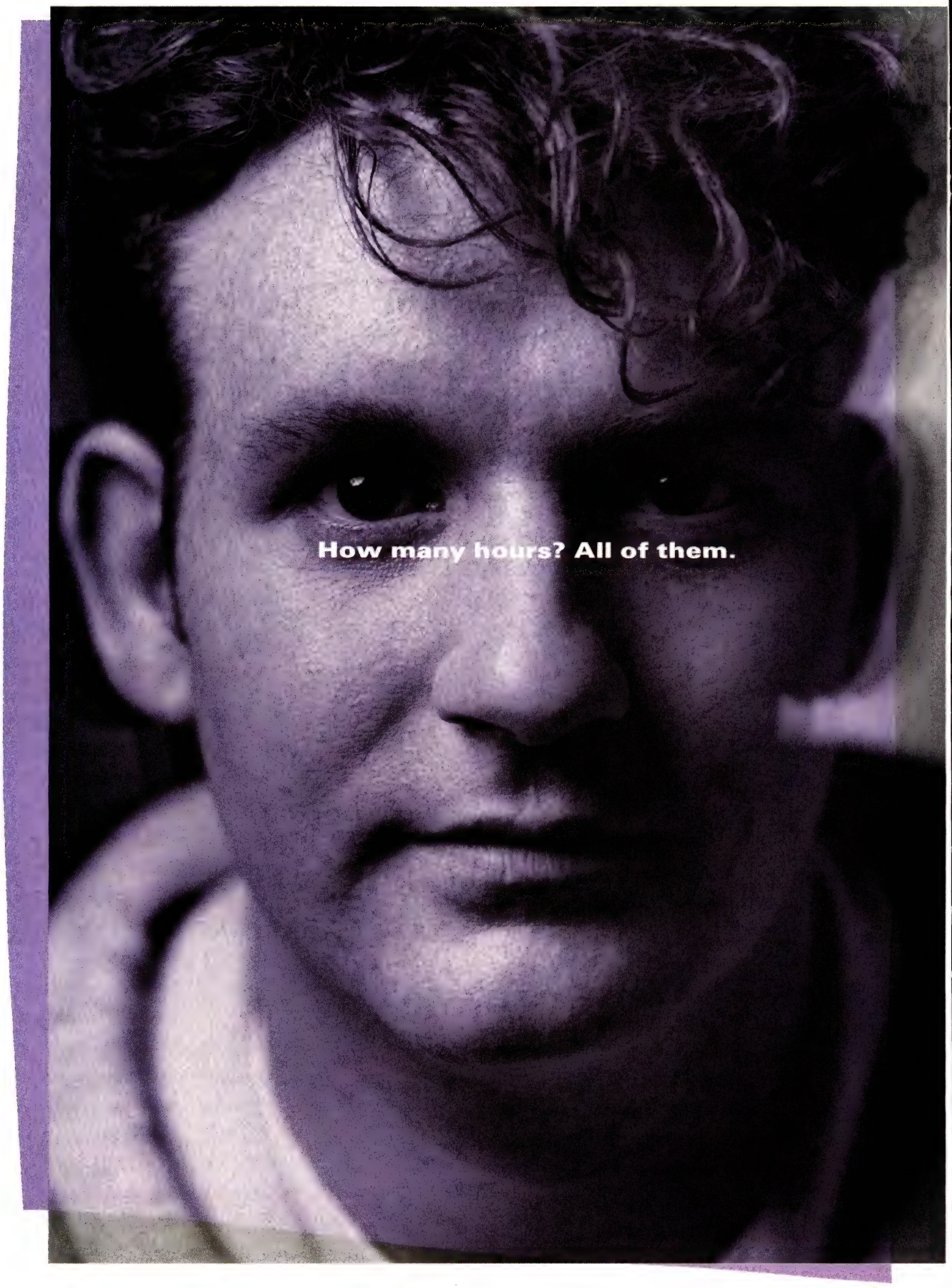
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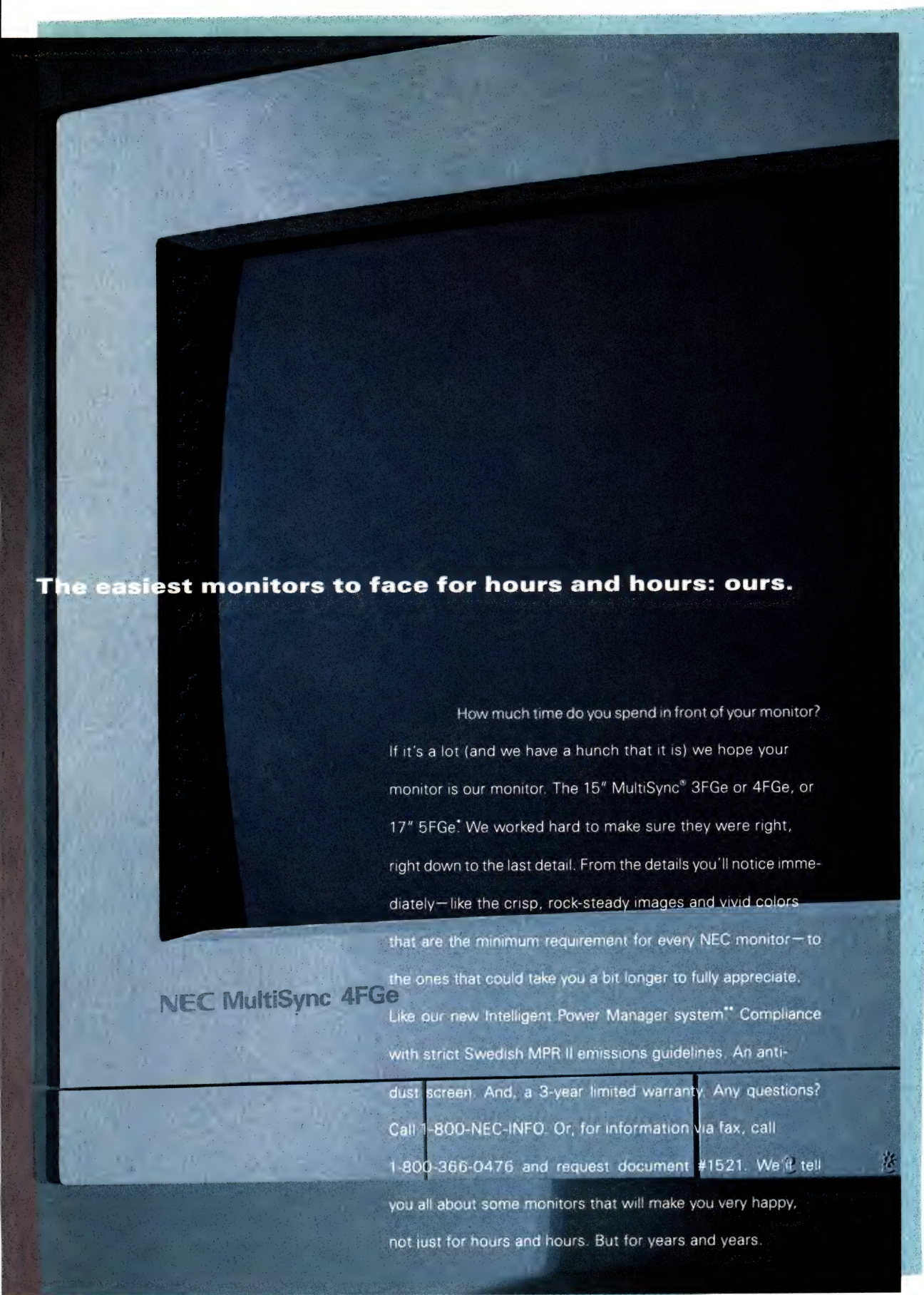

Four hours Monday, six hours Tuesday, eight hours...


An hour here. An hour there.


Eighteen hours today.


Tomorrow, who knows?


How many hours? All of them.



The easiest monitors to face for hours and hours: ours.

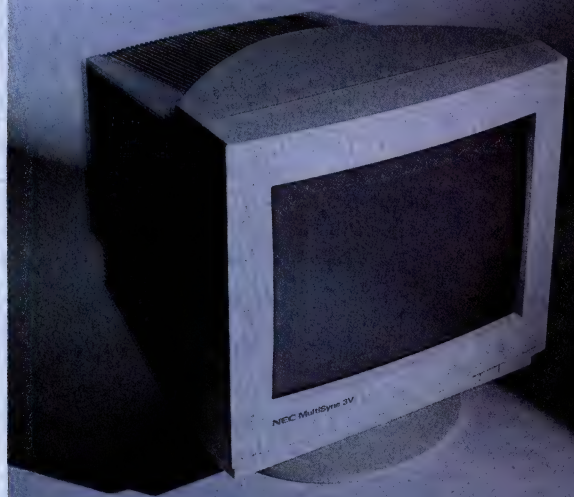
How much time do you spend in front of your monitor? If it's a lot (and we have a hunch that it is) we hope your monitor is our monitor. The 15" MultiSync® 3FGe or 4FGe, or 17" 5FGe.* We worked hard to make sure they were right, right down to the last detail. From the details you'll notice immediately—like the crisp, rock-steady images and vivid colors that are the minimum requirement for every NEC monitor—to the ones that could take you a bit longer to fully appreciate. Like our new Intelligent Power Manager system.** Compliance with strict Swedish MPR II emissions guidelines. An anti-dust screen. And, a 3-year limited warranty. Any questions? Call 1-800-NEC-INFO. Or, for information via fax, call 1-800-366-0476 and request document #1521. We'll tell you all about some monitors that will make you very happy, not just for hours and hours. But for years and years.

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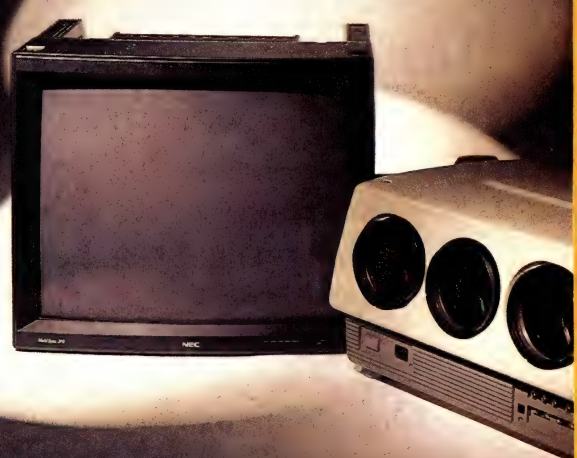




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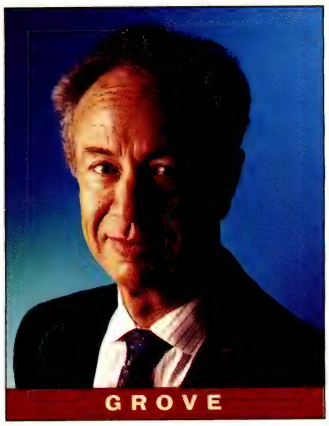
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Uncompromised quality and reliability
for large screen presentations.
27" MultiSync 3PG Data Monitor. FastFacts document #37401.
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For literature on any of these products, call 1-800-NEC-INFO. For information immediately via fax, call NEC FastFacts™ at 1-800-366-0476 and request the listed document number.

• *Person of the Year*

Andrew S. Grove

Few people embody the computer industry or the American dream as well as Andrew S. Grove. Both as an engineer and manager, Grove has left his personal stamp on electronics and personal computing. Born in 1936 in Budapest, Hungary, Grove emigrated to the U.S., where he graduated from The City College of New York. He later received his Ph.D. from the University of California at Berkeley. He then joined the Research and Development Laboratory of Fairchild Semiconductor, where he did pioneering work in integrated circuits. In 1968 Grove joined the new-founded Intel Corp., where he was named president and COO in 1979. He became the firm's chief executive officer in 1987.


GROVE

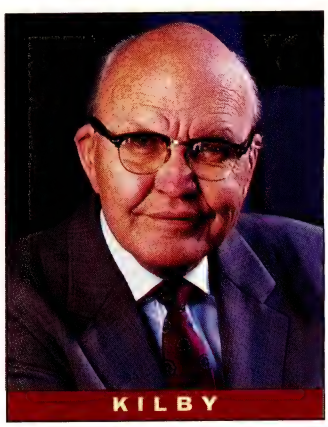
Intel has long been at the forefront of the PC industry, and in 1992 became the world's largest semiconductor manufacturer. In 1993 Intel introduced the Pentium processor, which offers an advanced superscalar design while maintaining compatibility with Intel's *x*86 architecture and the thousands of popular PC applications written for it over the past ten years. In addition, the company has defined the PCI bus design, which may well become the high-performance bus standard for the next generation of personal computers. Under Grove, Intel has remained a leader in many other areas. Most recently, it has expanded its horizons through the development of a large line of networking and communications products, as well as through pioneering work in video compression, embodied in its Indeo technology. By investing in both current and future technologies, Grove has positioned Intel as one of the most important trend-setters in the PC industry.

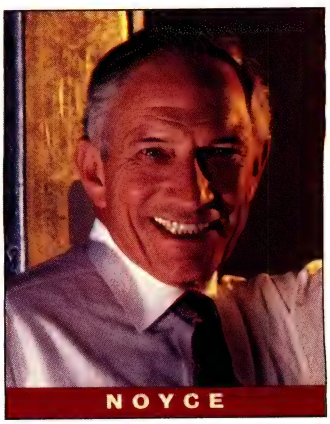
• *Lifetime Achievement*

Jack St. Clair Kilby and Robert N. Noyce

The computer industry as we know it stems from the accumulated inventions and innovations of many thousands of creative people working over a 45-year span. But the foundation of every modern computer—and virtually all consumer-electronics devices—is a single technology: the integrated circuit. The IC is so ubiquitous that we often take it for granted, but 35 years ago it was anything but obvious.

In the summer of 1958, Jack St. Clair Kilby, then a new employee at Texas Instruments, came up with the idea of combining transistors, resistors, and capacitors in a single semiconductor. In September of 1958, Kilby created a working demonstration of this "monolithic" integrated circuit half the size of a paper clip. In early 1959 at Fairchild Semiconductor, Robert N. Noyce introduced the idea of building an IC with components connected by aluminum lines deposited on a silicon-oxide surface layer bonded to a plane of silicon. This landmark invention—the basic metal-oxide-silicon (MOS) structure—opened the way for mass production. Kilby continued to work on other inventions, including the first electronic hand-held calculator. He left TI in 1970 to become a consultant, professor, and independent inventor. Noyce, who had earlier left Shockley Semiconductor to cofound Fairchild Semiconductor, left Fairchild in 1968 to cofound Intel Corp. with Gordon Moore. Noyce was Intel's first president, during the period when the firm developed such innovations as dynamic RAM and the first microprocessor—the basic building blocks of PCs. At his death in 1990, he was vice chairman of Intel and CEO of Sematech, a U.S. government/industry consortium designed to develop advanced semiconductor manufacturing technology. Recognized as the coinventors of the integrated circuit, Kilby and Noyce laid the groundwork for today's electronics industry and for the PC.


KILBY


NOYCE

PHOTOGRAPHS BY ROBERT HOLMGREN (TOP); CHARLES THATCHER (LOWER LEFT); ZIGY KALUZNY (LOWER RIGHT)

COREL DRAW!

CorelDRAW Sweeps the ratings... again!

The World's Best Graphics Software!

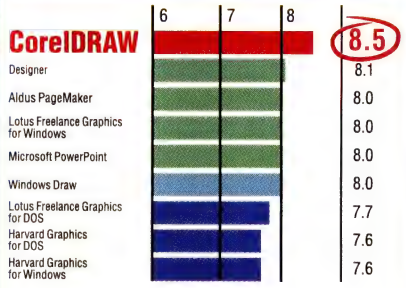
DRAW!

Best Overall!

PC MAGAZINE

Best Support!

How Readers Rated Software: Graphics



How Readers Rated Technical Support: Graphics

CorelDRAW	8.5
Designer	8.1
Microsoft PowerPoint	7.9
Windows Draw	7.9
Harvard Graphics for Windows	7.8
Aldus PageMaker	7.6
Lotus Freelance Graphics for Windows	7.5
Harvard Graphics for DOS	7.4
Lotus Freelance Graphics for DOS	7.3

WINNER OF OVER 100 FIRST PLACE AWARDS

"...graphics has a hands-down winner in both support and satisfaction – CorelDRAW!"

"CorelDRAW was the only graphics program that users rated significantly above average. This diverse category included everything from desktop publishers to paint programs."

PC MAGAZINE, July 93



In a recent *PC Magazine* poll, readers voted CorelDRAW "by far" the best overall graphics software package as well as the best in technical support.

Winner of these and over 100 international first place product awards, CorelDRAW is celebrated worldwide for its ease of use, incredible value and outstanding features! Its precision type control, superb drawing power and amazing special effects make it easy for anyone to create dynamic desktop publishing documents and colorful presentations.

In addition to powerful illustration tools, you'll also receive CorelCHART, Corel PHOTO-PAINT and CorelSHOW – all in one value-packed box! CorelDRAW 3 also includes a CD-ROM with over 250 type fonts and 14,000 clipart images and symbols.

CorelDRAW is the greatest value in software ever – no wonder it's the world's best selling graphics software!

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COREL

KUR-0026

Awards for Technical Excellence: Previous Winners

1992

WINNER	COMPANY	CATEGORY
AMD 3.3-volt CPUs	Advanced Micro Devices Inc.	Components/ Subsystems
Borland C++ 3.1	Borland International Inc.	Development Tools
Compaq Deskpro 66/M	Compaq Computer Corp.	Systems
Ecosys a-Si Printer FS-1500A	Kyocera Electronics Inc.	Printers
Fractal Design Painter for Windows, Version 1.2	Fractal Design Corp.	Graphics Applications
Knowledge Adventure Interactive Books	Knowledge Adventure Inc.	After Hours
Microsoft Windows for Workgroups	Microsoft Corp.	Networking/ Communications
NEC InterSect CDR-74	NEC Technologies Inc.	Peripherals
OS/2, Version 2.0	IBM Corp.	Operating Systems and Software Standards
PCMCIA, Release 2.0	Personal Computer Memory Card International Association	Hardware Standards
Quattro Pro for Windows	Borland International Inc.	Applications
Toshiba T4400SXC	Toshiba America Information Systems Inc.	Portables
Michael S. Dell	Dell Computer Corp.	Person of the Year
Raymond J. Noorda	Novell Inc.	Lifetime Achievement

1991

WINNER	COMPANY	CATEGORY
Altair Wireless Ethernet	Motorola Inc.	Connectivity
FoxPro, Version 2.0	Fox Software Inc.	Applications Software
IBM LaserPrinter 10	Lexmark International Inc.	Printers
Microsoft Visual Basic	Microsoft Corp.	Development Tools
PenPoint	GO Corp.	Standards and Operating Systems
SimEarth	Maxis	After Hours
Stacker, Version 1.1	Stac Electronics	Utilities
Toshiba T2200SX	Toshiba America Information Systems	Portable Computers
Daniel Bricklin and Robert Frankston	Slate Corp.	Lifetime Achievement
Philip D. (Don) Estridge	IBM Corp.	Person of the PC Decade
Philippe Kahn	Borland International Inc.	Person of the Year

1990

WINNER	COMPANY	CATEGORY
Compaq Systempro	Compaq Computer Corp.	PCs
Compton's MultiMedia Encyclopedia	Britannica Software Inc.	Entertainment/ After Hours
Developer's RenderMan	Pixar	Software
Edsun Continuous Edge Graphics	Edsun Laboratories Inc.	Emerging Technology
HP LaserJet III	Hewlett-Packard Co.	Hardware
HP NewWave, Version 3.0	Hewlett-Packard Co.	Operating Environments
LANtastic Voice Adapter	Artisoft Inc.	Connectivity
Sharp PC-6220	Sharp Electronics Corp.	Portables
Texas Instruments TravelMate 2000	Texas Instruments Inc.	Portables
Turbo C++ Professional	Borland International Inc.	Development Tools
Xircom Pocket LAN Adapter	Xircom Inc.	Design
Finis Conner	Conner Peripherals	Persons of the Year
Adele Goldberg	Xerox's Palo Alto Research Center	Lifetime Achievement
Terry Johnson	PrairieTek	Persons of the Year

1989

WINNER	COMPANY	CATEGORY
Audio Visual Connection	IBM Corp.	Hardware
Autodesk Animator	Autodesk Inc.	Graphics
IBM LaserPrinter	IBM Corp.	Printers
Lotus Magellan	Lotus Development Corp.	Utilities
MultiScope OS/2 Debugger	Logitech Inc.	Development Tools
NetWare 386, Version 3.0	Novell Inc.	Connectivity
OS/2, Version 1.2	IBM Corp., Microsoft Corp.	Operating Environments
The Poqet PC	Poqet Computer Corp.	Portables
Quattro Pro	Borland International Inc.	Applications
Roland LAPC-I	Roland Corp. US	Entertainment/ After Hours
Joseph R. Canion	Compaq Corp.	Person of the Year
John Warnock	Adobe Systems Inc.	Lifetime Achievement


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Hard disk ☐170MB ☐240MB ☐340MB ☐440MB

MINITOWER (8x6)

Processor ☐486 Blue Lightning, 66 MHz ☐486DX2, 66 MHz

Memory ☐4MB ☐8MB ☐16MB ☐32MB ☐64MB

Hard disk ☐170MB ☐240MB ☐340MB ☐440MB

EISA DESKTOP (8x6)

Processor ☐486DX2, 66 MHz ☐Pentium, 60 MHz

Memory ☐8MB ☐16MB ☐32MB ☐64MB

Hard disk ☐170MB ☐240MB ☐340MB ☐440MB ☐540MB SCSI-2*

EISA TOWER (8x12)

Processor ☐486DX2, 66 MHz ☐Pentium, 60 MHz

Memory ☐8MB ☐16MB ☐32MB ☐64MB ☐Other ____MB

Hard disk ☐170MB ☐240MB ☐340MB ☐440MB ☐540MB SCSI-2

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OPTIONS

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Graphics accelerator ☐ATI® Ultra Pro Graphics VL™

Printers & scanners ☐IBM Personal Printer II (24-pin) ☐IBM LaserPrinter 4039 (12 ppm) ☐IBM LaserPrinter 4029 (10 ppm, 6 ppm) ☐Calera WS Complete PC Scanner

SOFTWARE

Word processing ☐Lotus Ami Pro ☐Microsoft Word® ☐WordPerfect

Accounting ☐Quicken

Spreadsheet ☐Microsoft Excel® ☐Lotus 1-2-3 ☐Quattro Pro

Graphics/ presentation ☐Lotus Freelance Graphics ☐Microsoft PowerPoint®

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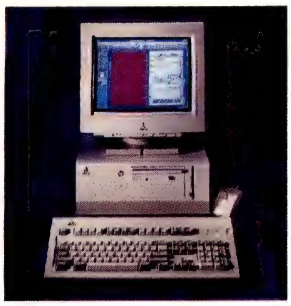
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- Minitower casing (8 x 6)
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Awards for Technical Excellence: Previous Winners (continued)

1988

WINNER	COMPANY	CATEGORY
All Chargecard	All Computers	Add-in Boards
ALR FlexCache 25386	Advanced Logic Research Inc.	Desktop Machines
Kurta IS/ONE Cordless Stylus/Puck	Kurta Corp.	Hardware
Lahey Fortran 286 and 386	Lahey Computer Systems Inc.	Compilers/ Languages
Micrografx Designer	Micrografx Inc.	Graphics Software
Microsoft Mouse	Microsoft Corp.	Design
NEC UltraLite	NEC Home Electronics (U.S.A.) Inc.	Portables
Q&A, Version 3.0	Symantec Corp.	Application Software
SunRiver Workstation	SunRiver Corp.	Connectivity
Turbo Debugger	Borland International Inc.	Development Tools
VM/386	Intelligent Graphics Corp.	386 Software Technology
Intel 80386 Design Team	Intel Corp.	Persons of the Year
Dennis Ritchie	AT&T Bell Laboratories	Lifetime Achievement

1987

WINNER	COMPANY	CATEGORY
AutoShade	Autodesk Inc.	Graphics Software
Compaq Deskpro 386/20	Compaq Computer Corp.	Desktop Computers
Compaq Portable 386	Compaq Computer Corp.	Portable Computers
LIM Expanded Memory Specification 4.0	Lotus Development Corp., Intel Corp., Microsoft Corp.	Utilities
Lucid 3D	Personal Computer Support Group	Application Software
Micro Channel architecture	IBM Corp.	Special Category
Microsoft Excel for Windows	Microsoft Corp.	Application Software
Microsoft Windows/ 386	Microsoft Corp.	Operating Environments
Publisher's Type Foundry	ZSoft Corp.	Desktop Publishing
QuickBASIC, Version 4.0	Microsoft Corp.	Development Tools
3Com 10Mb Twisted Pair	3Com Corp.	Connectivity
Turbo Pascal, Version 4.0	Borland International Inc.	Development Tools
Zenith Perfect Monitor, Model ZCM-1490	Zenith Data Systems	Hardware
Douglas Engelbart	McDonnell Douglas Information Systems Group	Lifetime Achievement

1986

WINNER	COMPANY	CATEGORY
Advanced NetWare/ 286	Novell Inc.	Networking
Compaq Deskpro 386	Compaq Computer Corp.	Desktop Computers
Lotus HAL	Lotus Development Corp.	Software Add-ons
Microsoft Windows, Version 1.03	Microsoft Corp.	Environments
NEC MultiSync	NEC Home Electronics (U.S.A.) Inc.	Graphics Hardware
NewViews	Q.W. Page Associates Inc.	Application Software
Perspective	Three D Graphics	Graphics Software
QuickBASIC 2	Microsoft Corp.	Programming Languages
TIPS	Island Graphics Corp.	Graphics Software
Toshiba T3100	Toshiba America Information Systems Inc.	Portable Computers
What's Best!	General Optimization Inc.	Software Add-ons
Zenith Z-181 Portable PC	Zenith Data Systems	Portable Computers
Bill Gates	Microsoft Corp.	Special Award

1985

WINNER	COMPANY	CATEGORY
Apple LaserWriter	Apple Computer Inc.	N/A
EGA CHIPset	Chips & Technologies Inc.	N/A
Freelance	Lotus Development Corp.	N/A
IBM Proprinter	IBM Corp.	N/A
Javelin	Javelin Software Corp.	N/A
LANLink	The Software Link	N/A
Plus Hardcard	Plus Development Corp.	N/A
Trailblazer modem	Telebit Corp.	N/A
Mike Brown	Central Point Software	Special Award

1984

WINNER	COMPANY	CATEGORY
Enable	The Software Group	N/A
Framework	Ashton-Tate Corp.	N/A
Infoscope	Microstuf	N/A
Intel 80286	Intel Corp.	N/A
PC Blue Series	(Public domain)	N/A
Turbo Pascal	Borland International Inc.	N/A

N/A—Not applicable: Winners were not designated by category in 1984 and 1985.



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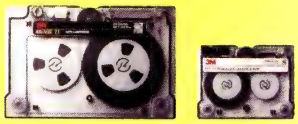
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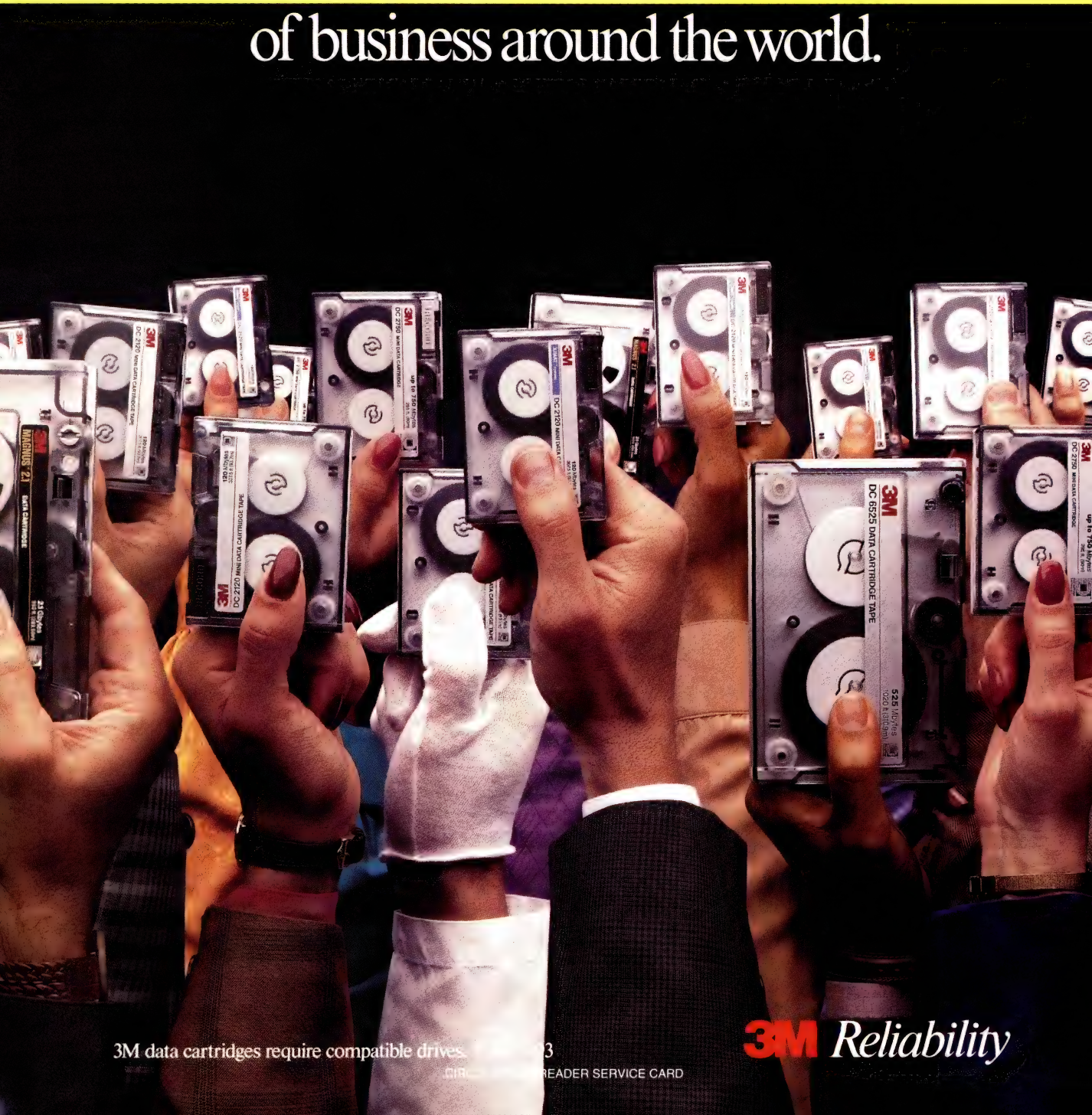
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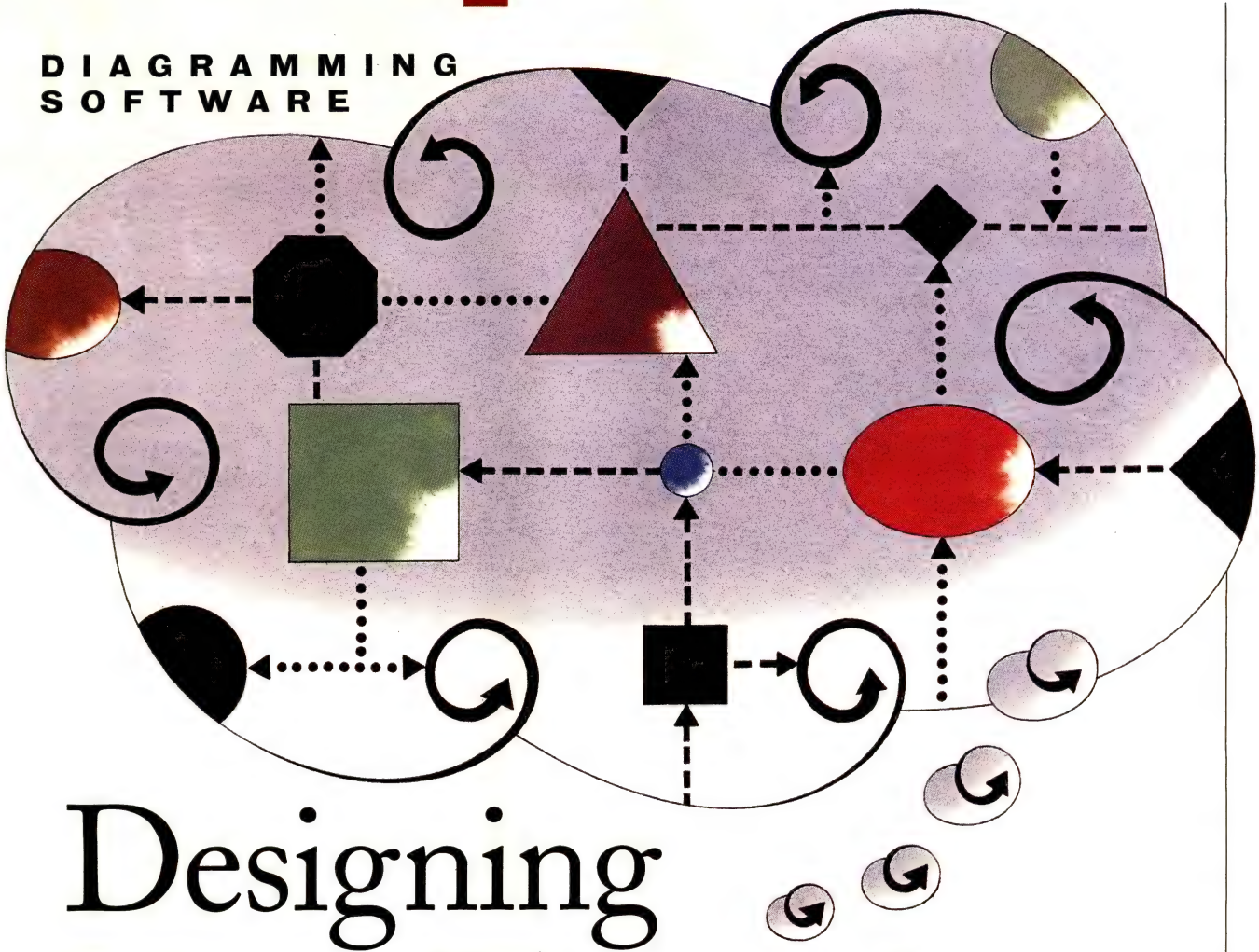


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DIAGRAMMING SOFTWARE



Designing Your Thoughts

A look at packages that will allow you to create organization charts, flowcharts, or a variety of business graphics.

by Rock Miller

Sometimes it's easier to show than it is to explain. That's the idea behind diagramming software. The tools in this somewhat broad category tend to fall into two groups: the single-purpose packages that allow you to create only one type of connection-based diagram, such as flowcharts or organization charts, and the multipurpose packages that allow you to create these types of charts, as well as non-connection–based diagrams, such as Venn diagrams and even floor plans. What all of these programs allow you to do is to pick a symbol from a palette or library and place it into your chart. Add some text and the appropriate connecting lines, and you've got a diagram.

If all you need to do is create the same type of chart over and over again, be it a process chart showing how to program your VCR or the new hierarchical structure of your realigned

Illustration by Philip Anderson

company, turn to the section of this story on "Flowcharting & Organization Charting". If your diagramming needs are varied, or you'd like some freehand drawing capabilities as well as the ability to create symbol-based illustrations, take a look at the six multipurpose tools in the following reviews.

ADS Diagrammer, Version 2.1, from Atlantic Design Systems ($199) is the perfect size for most ordinary diagramming needs. Its clean, well-designed interface lets you make quick work of simple diagrams and requires very little training time, yet Diagrammer is packed with considerable power. It offers the ability to create and save customized symbol palettes and to link diagrams into hierarchical networks.

Alignment tools (which are built around a live preview of the diagram, and which include distribution and align-to-page options) are exceptionally well implemented. Though symbols are not connected to a style sheet, an Apply Style option lets you make global symbol substitutions in a single, quick operation.

Connecting symbols is an equally simple task: You can autoconnect symbols as you draw or simply trace the connection, either directly or in steps. You can adjust the routing of connectors simply by dragging their control points, and Diagrammer's innovative "control polygon" is one of the easiest methods we've seen for reshaping curved connectors. You can snap connectors to the edge of objects as well as to their centers and you can even adjust line widths globally for printing (though, unfortunately, not with dashed or dotted lines).

Diagrammer's only major flaw lies in its poor implementation of the right-angle connectors used in organization charts. You must specify the path of the right-angle connectors manually, and once you've created them, there's no automated way of getting multiple connectors to match up with each other into the familiar tree structure. This made our test orgchart slower and more difficult to create than it should have been.

Surely there are more powerful diagramming packages available, but none combine the right level of power with ease of use as smoothly as ADS Diagrammer, Version 2.1.

Chartist-2, Version 2.04, from Novagraph is the blue-plate special in this bunch. Low in price ($125) and basic in its capabilities, it gets the job done with a minimum of fuss. Most likely, however, you'll demand more than its limited capabilities can supply.

Chartist-2 features two symbol libraries, one of which forces you to create your own shape coordinates in ASCII text format; the library that is included in the package contains mostly simple outlines suitable for flowcharts and other abstract flow diagrams. It does have a few rather crude representations of computer equipment—good enough for us to create our network diagram. You can place the shapes that you most commonly use on the single right-hand shape palette; otherwise, you select them by 16-character code from a pop-up menu, which also sets other symbol attributes such as border width and text orientation.

This no-frills approach does provide speed in drawing and connecting symbols. In fact, the connector scheme is admirably simple: Instead of having to select the right type of connectors based on the type of routing, you can use Chartist-2's single connecting tool to do the job. And, in simple diagrams, it's usually right the first time. When it doesn't work, however, you are forced into awkward workarounds.

Because you can't directly adjust the path of right-angle connectors, you need to use dummy "waypath" objects to route them around other objects. Chartist-2 also suffers from baffling intermittently slow performance, which makes it frustrating to position and adjust your diagram precisely. Though Chartist-2 offers alignment tools, the selection is rather skimpy, and you can only align on a shape's center vertically or horizontally.

Chartist-2 is suitable for occasional use on simple drawings, but it just isn't capable enough to grow with you. While its ease of use is gratifying, its limitations can be grating.

HIGHLIGHTS

Diagramming Software

DIAGRAMMING SOFTWARE lets you illustrate a process or structure. These packages fall into two categories: the single purpose tools, such as a flowcharter or an orgcharter, that are geared toward a specific task, and the multipurpose tools that give you a wider array of diagram types.

MULTIPURPOSE DIAGRAMMING programs allow you to create other types of diagrams and structured illustrations, such as Venn diagrams, space plans, and landscape layouts.

FLOWCHARTS AND ORGCHARTS both convey information through a series of symbols and connectors. Typically, flowcharts depict processes while orgcharts depict hierarchical structures. The more established flowcharting packages are DOS-based, but they lack the flexibility of the Windows-based programs.

BOTH THE SINGLE- AND MULTI- purpose packages give you libraries of symbols that you can use to create your diagrams. With most of the packages, you simply grab a symbol from the library and drop it into your chart.

ANOTHER COMMON TRAIT among many of these packages is the use of "intelligent" connectors, what IntelliDraw calls Connectigons, that make it easy to reposition objects without having to relink them to the rest of the objects in a diagram.

WHICH IS BEST? The single-purpose packages give you just the tools you need to create one specific type of chart, and generally offer a gentler learning curve. What the multipurpose packages offer is greater flexibility, more symbol types, and some freehand drawing tools.

PC MAGAZINE

EDITORS' CHOICE

- *Multipurpose Tool:*.....**Visio, Version 1.0**
- *Single-purpose Tool:*.....**ABC FlowCharter, Version 2.0**

For power and usability in diagramming and structured illustration, it's hard to top Shapeware Corp.'s Visio, Version 1.0 ($299). Its drag-and-drop drawing metaphor, easy-to-use tools, and wide selection of SmartShapes objects make it a rich and rewarding tool for business users needing to create diagrams and technical drawings.

The package provides stencils full of innovative SmartShapes—easily customizable symbols that contain information about how lines should connect to a shape as well as how the associated text should be formatted. Once you've dropped the shapes onto the page, the package provides a full complement of tools for editing and aligning these objects. Look for Version 2.0 of the product (available by the time you read this) to make the SmartShapes even smarter and easier to use.

Like Visio, Micrografx's $495 ABC FlowCharter, Version 2.0, weaves a broad set of features into an intuitive interface. It offers the widest selection of shapes of any flowcharting program, a powerful set of alignment features, and easy-to-use connector lines. FlowCharter can handily generate an orgchart as well. If flowcharting is vital to your corporate existence, this Windows package is the one to choose.

MetaDesign for Windows, Version 4.0, from Meta Software Corp. focuses on the relationships that diagrams represent, rather than on the diagrams themselves. This $350 package includes a reasonable selection of symbol libraries backed by a toolbar of continuous symbols and basic arrangement tools, which make it a solid package for creating reasonably attractive diagrams. Its real distinction, however, lies in its ability to manage large charts with multiple levels of detail.

Not only can you attach bidirectional links between any two objects or between an entire drawing page and any other diagram, but the program also lets you organize multiple drawings into tree-structured *projects* that can be managed as units. The MDI (Multiple Document Interface) format lets you keep multiple diagrams and multiple symbol palettes open at once, and you can navigate the links between diagrams using well-designed visual tools. Ten individually hideable and protectable layers are available as well.

Though MetaDesign is a fairly complicated piece of software with an abundance of tools and options, those tools give you an edge in productivity. The program's alignment tools, for instance, are particularly useful. In addition to the usual horizontal and vertical alignments, there are also various ways to distribute objects, make them equal in size, and fit them to the text inside—all of which can be tremendous timesavers. You can group-select connectors independently from boxes, and you can easily change connector attributes (such as curvature and arrow size and type) individually or en masse through a single dialog box.

Selecting the boxes from the symbol palettes and connecting them proved to be quick and simple on our tests. The selection of symbol libraries is quite adequate, and they are easily customizable. However, in fine-tuning the results, we ran into a number of obstacles. When drawing our test orgchart, for example, we found it difficult to get individual right-angle connectors to snap into alignment with each other. Furthermore, MetaDesign has no provision for branching connectors, which means you have to fake it. In our test flowchart, for instance, we had to use extremely small invisible circles to make branched connector junctions.

The diagrams MetaDesign can create are attractive, if not overwhelmingly so. The selection of line weights and arrowheads is adequate (you can even fill arrowheads separately from line colors), but only for solid lines—you can't adjust the weights of dashed and dotted lines. Text handling could be better as well: You can't vary styles within a single text block, and you won't find any paragraph or margin settings.

MetaDesign's relatively high list price may deter the cost-conscious. Indeed, for most simple charting jobs, you can do just as well with ADS Diagrammer, which is similar in many ways but easier to use. If, however, you need a package that will handle large flow diagrams with aplomb, MetaDesign is worth its price.

Aldus IntelliDraw, Version 1.0 ($299), from Aldus Corp. is a powerful program. Using it to create a diagram may seem at first like using a howitzer to get rid of a pesky fly. This innovative program is loaded with complex features, and as a result, it takes more effort to master than you might be willing to invest if all you need to create is simple connector-based charts. For those who need the utmost in flexibility, however, IntelliDraw's unique linking and connection features make it a fine tool for highly designed diagrams. Add in the freehand drawing tools and the ability to link data to graphics and to create simple animations, and you have a powerful tool for producing a variety of structured illustrations. The $199 Version 2.0, which should be available by the time you read this, will make IntelliDraw easier to use.

IntelliDraw departs significantly from its competitors in its operating metaphor.

Our Contributors: JOHN MOORE is a staff editor at *PC Magazine*. BRENDON M. MACARAEG is an editorial researcher at *PC Magazine*. ROCK MILLER is a former associate editor of and a frequent contributor to *PC Magazine*. STEPHEN W. PLAIN is a frequent contributor to *PC Magazine*. GAYLE C. EHRENMAN was the associate editor in charge of this story and JEFF MACE was the project leader.

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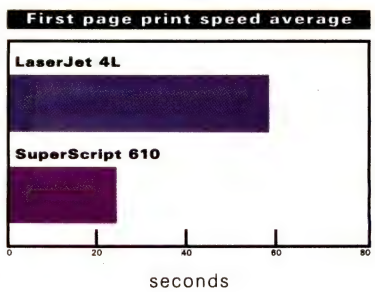
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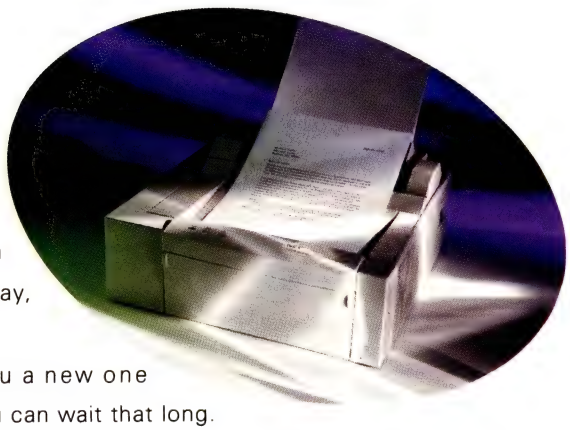


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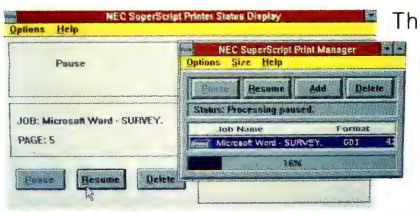
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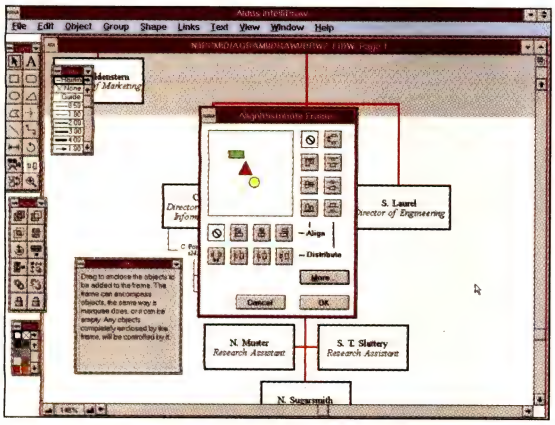
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Although you can cut and paste a few predefined elements from the sample clip art files, IntelliDraw doesn't have symbol palettes per se. Instead, you build up diagrams from simpler drawing elements



IntelliDraw's align/distribute feature provides you with complete control over the structure of your diagrams.

(whether they are simple shapes, complex symbols, text blocks, or groups) and tie them together with intelligent connectors. This approach is more time consuming than simply stamping out symbols, but it also gives you greater control over the appearance and behavior of the elements.

For diagramming purposes, IntelliDraw offers a wide variety of methods to preserve relationships between elements. The program's links let you lock in the results of the last auto-align action (but not, unfortunately, the alignments performed through align/distribute actions). You can also employ linking to maintain sizes, positions, alignments, or distributions of elements. We used it, for instance, to "glue" workstations and connecting cables to the Token-Ring in our network diagram. Finally, you can use the aptly named Connectigon tool to create complex connections between three or more objects, or to create connections with curved as well as straight paths. In addition, you can link numeric data to graphic objects so that when you change the numbers, the elements of the chart adjust to reflect the change.

Using these features properly takes time, training, and planning, but the results can be easy to edit. In our test flowchart, for example, we used IntelliDraw's Point function to terminate and intersect connector segments; these remained when the original objects and their connectors were removed. Therefore, reconnecting the remaining objects with new ones took only a few seconds. We also used Point to create snap points on the borders of the triangular node in our flowchart. Links, however, should be used sparingly: Your system—a fast 486 is a practical minimum—can quickly bog down if the diagram has too many active links.

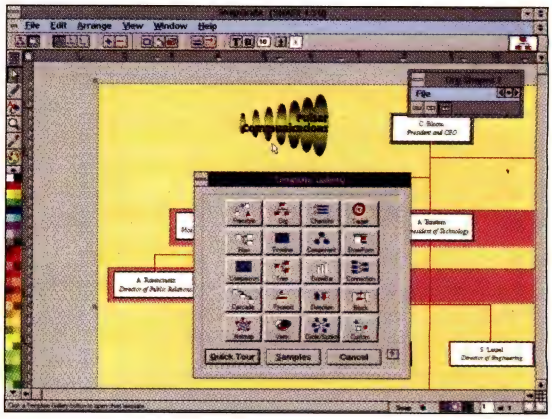
Even with its powerful features, IntelliDraw proved to be burdened with a number of flaws. One baffling aspect is that in order to edit the nodes of the default right-angle connectors, you have to move the entire object. IntelliDraw lacks master objects (in terms of stencil or shape libraries) and doesn't allow you to select connectors independent of shapes through its menus, which can make global attribute changes a trial of sorts.

Version 2.0, due out by the time this is in print, should go a long way toward correcting some of these flaws. In addition to improving the speed and performance of the product, this version will add drag-and-drop drawing capabilities, smarter connectors, and an attribute control palette to make it easier to implement global changes to a drawing.

Diagramming merely begins to scratch the surface of IntelliDraw's power, and it's certainly not the right choice if ease of use is your primary goal. But if you need to invest in a flexible and innovative tool that won't put any limitations on the quality of the final results, you'll be satisfied with IntelliDraw.

As the name implies, the core of SnapGrafx is its snappable grid on which you can place chart objects much as you would plug in building blocks. In addition to the grid, the rest of the working environment—the symbol palette, the toolbar, even the help system—adapts systematically to the type of chart you're trying to create. Adjustments are so simple that you almost don't have to use the menus. For instance, you can adjust the spacing and size of the grid elements simply by dragging on the handles positioned around the edges of the drawing area. And, if you adjust the size of a chart object while the corresponding tool on the symbol palette is selected, the next and subsequent instances of the object take on the new size. The program's "auto-draw" capabilities let you generate the appropriate connectors on the fly as you place objects on the page.

SnapGrafx supports a wide variety of charts, including 3-D block and pyramid charts, Venn diagrams, connection charts, network diagrams, circle-spoke arrangements, even check-off forms—all with customized tools, objects, and on-line help. These charts are adapted for distinctive (some would say flashy) results: The "freestyle" diagram mode, for example, includes bold outline arrows and spheri-



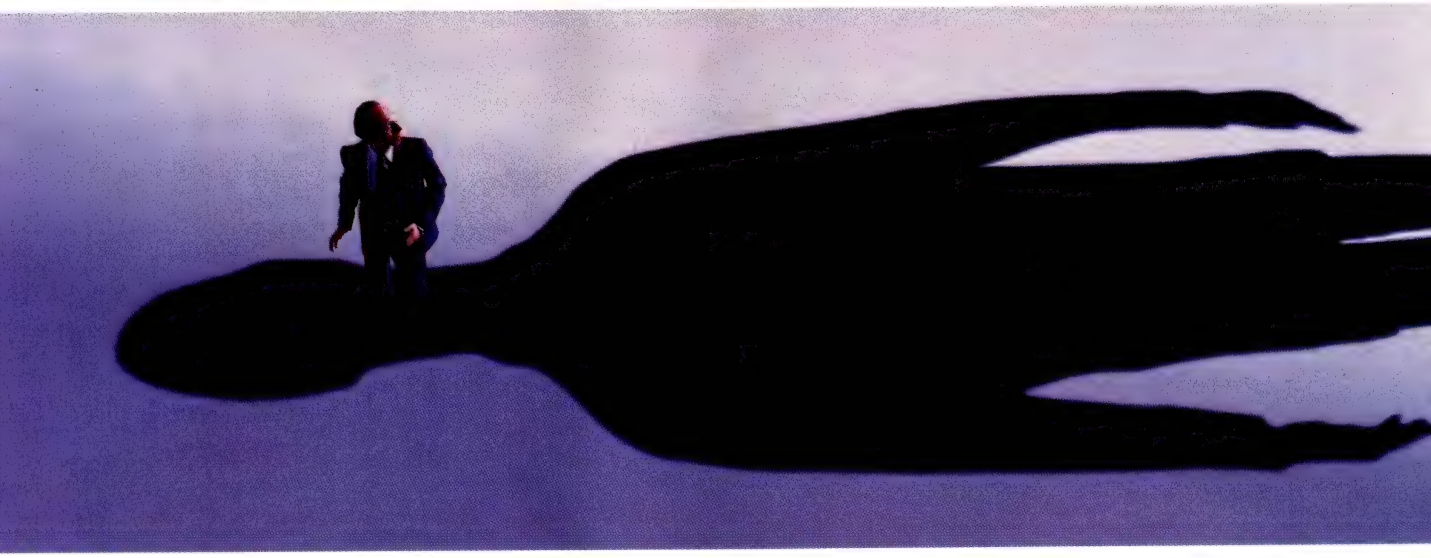
SnapGrafx sports a detailed gallery for creating a wide variety of charts.

SnapGrafx, Version 1.0, from Micrografx is a product designed with the business user in mind. This new program from Micrografx (listing for $295; $99 until Dec. 31) abounds with clever features within a novel yet easy-to-learn working environment. Its potential to smooth the creation of arresting and unusual charts is great, but this early version we tested still needs a bit of polish.

cal-appearing objects, and you can jazz up all the charts considerably using the program's extensive color, shadow, and 3-D effects.

Unfortunately, when it comes to more naturalistic diagrams, SnapGrafx falls down a bit. Its selection of symbols for computer equipment, for instance, which

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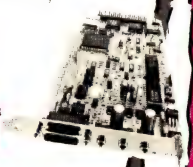


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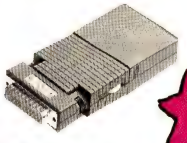
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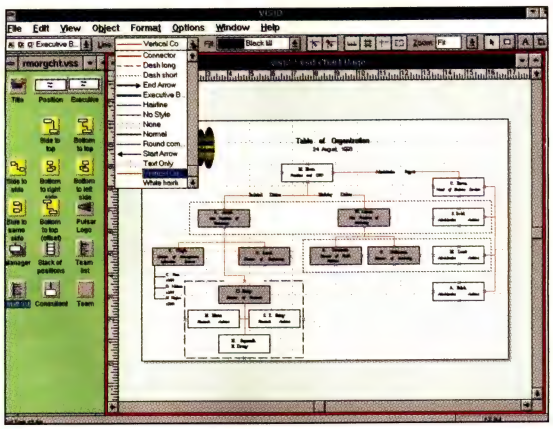
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we needed for our freehand network diagram, is minimal.

You should also be aware that SnapGrafx suffers from its fair share of minor glitches commonly found in new software products. Text often aligns imperfectly, especially with 3-D objects, forcing you to reposition elements manually to make it look right. Furthermore, you can't unhook objects from an underlying grid even temporarily (except in certain types of charts), so if you decide to make the grid finer, all your objects become scrunched, meaning you have to reposition them.

For quick business diagrams, it's hard to beat SnapGrafx's approach. If your needs stress quickness of creation, simplicity and directness of editing, and colorful 3-D effects, this is the product to try.

Visio, Version 1.0, ($299 from Shapeware Corp.; $129 until Dec. 31) boasts perhaps the richest and most innovative diagramming environment. Though its power comes at the price of some complexity (and requires a powerful PC for best results), the tradeoff is surprisingly reasonable. Visio accommodates the quick sketching of basic diagrams almost as well as it does the detailed construction of intricate ones. By the time you read this, the even more powerful Version 2.0 will be available. This version, which shipped just after our testing ended, adds a variety of usability features, including a new toolbar, dynamic distribute capability, and improved SmartShapes stencils. In addition, 2.0 will offer one of the first implementations of Microsoft's OLE 2.0 specification, which lets you edit embedded objects "in place" without having to start up the originating application and drag and drop objects across applications.



Visio offers a variety of line styles that can be applied to orgcharts.

Visio is designed around a stencil metaphor. Like other diagramming programs, it has a palette window—called a *stencil window*—that contains predefined objects (or SmartShapes) that you use to build diagrams. Unlike other programs, however, once you've copied or *stamped* these symbols into your drawing, the connection between these copies and the stencil remains; that's where the "Smart" enters the picture. The stencil becomes part of the file's "master stencil" and controls the appearance and behavior of the copies to which it is linked.

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efits. Global changes, for one, are easy to accomplish: You simply edit the individual master items (using a pop-up edit window), and the new master attributes are propagated throughout the entire drawing. It also simplifies using your edited preferences and custom symbols in future drawings: You just save the master stencil to a file for reuse. Creating new copies of a master is simply a matter of dragging an existing copy while pressing the Ctrl key.

Though Visio's sophisticated behavior controls are best applied to space-planning tasks, they are useful for diagrams as well. For instance, assigning "reposition only" behavior to the workstation images in the Token-Ring assembly of our network diagram let us enlarge the Token-Ring group in a single operation without enlarging the workstations themselves.

Using Visio's connectors, which attach to connection points on the perimeter of the objects, is a little more complicated than in other packages. Typically, each stencil contains a selection of connectors for creating different types of connections (bottom-to-top, side-to-side, and so on), and you must pick the one that suits your needs. Editing charts sometimes requires a bit more than merely subtracting objects and regluing connectors. In the case of our test orgchart, for instance, we had to replace the bottom-to-top connectors with side-to-side connectors to get the objects to arrange themselves properly. The addition of control handles to the SmartShapes in Version 2.0 should eliminate this problem.

Visio is rich in drawing and editing facilities, including a strong set of drawing primitives, along with combine, intersect, and subtraction tools that let you build complex shapes from simple ones. Visio's styles, which can encompass text, line, and fill attributes, help enforce consistency independently of the master objects. Visio's alignment tools are supplemented by guide rules similar to PageMaker's, which are useful for lining up objects of disparate sizes and for trueing up connectors.

Visio also lets you assign three data fields per object, but about all you can do with them is display them as text labels—there's no way to access or manage them in table form. An inventory add-on shipping with Version 2.0 will take care of this.

A few minor glitches did manifest themselves during our testing. Though Visio offers the option of automatically sizing shapes to fit the text, the text alignment boxes don't track closely to the text itself. The installation program was excruciatingly slow, and owing to a printing glitch, dotted-format arcs failed to show up on our HP LaserJet II printer, although they did print properly in PostScript output.

The intelligence of Visio, Version 1.0, coupled with the improved usability and extensibility of the new release, should make this an even more impressive tool for business users.

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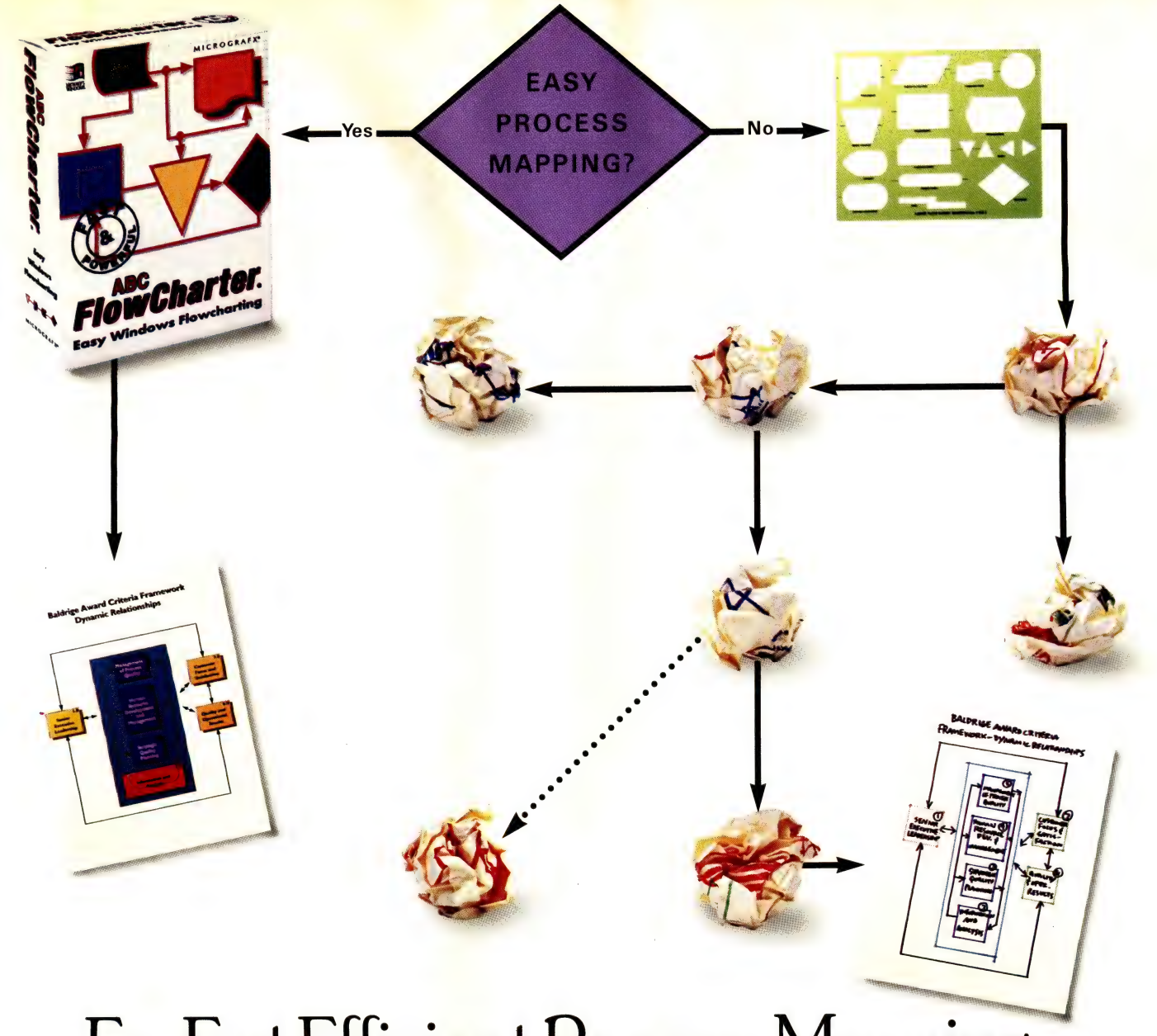
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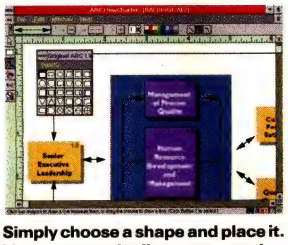
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MICROGRAFX®
ABC FlowCharter

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CIRCLE 361 ON READER SERVICE CARD

▶ SUMMARY OF FEATURES

Diagramming Software

Products listed in alphabetical order
■ = YES ☐ = NO

PC MAGAZINE EDITORS' CHOICE

	ADS Diagrammer, Version 2.1	Aldus IntelliDraw, Version 1.0	Chartist-2, Version 2.04	MetaDesign for Windows, Version 4.0	SnapGrafx, Version 1.0	Visio, Version 1.0
General Features						
List price	$199	$299	$125	$350	$295	$299
Minimum memory required	1MB	4MB	250K	4MB	2MB	4MB
Minimum disk space required	2MB	3.5MB	500K	2MB	2MB	2.8MB
File locking/sharing	■■	■☐	■☐	☐☐	■☐	■■
Fixed/variable zoom	■■	■■	■■	■■	☐■	■■
OLE 1.0 client/server	■■	■■	■■	☐■	☐■	■■
Undo/Redo	■☐	■■	■☐	■■	■■	■■
Chart Characteristics						
Maximum chart size (in inches)	47 x 47	100 x 100	60 x 60	60 x 60	100 x 100	Unlimited
Number of predefined chart types	15	13	None	7	20	17
Maximum number of positions per chart	Unlimited	Unlimited	N/A	Unlimited	40,000	Unlimited
Number of predefined shapes	300	1,252	100	32,000	300	600
Create customized shapes	■	■	■	■	☐	■
Draw shapes	☐	■	☐	■	☐	■
Create master shapes	■	■	☐	■	■	■
Create new stencil files	■	■	☐	■	■	■
Add colors to shapes	■	■	■	■	■	■
Text Characteristics						
Add text to shapes	■	■	■	■	■	■
Size/move text	■■	■■	■■	■■	■■	■■
Rotate text	■	■	■	☐	■	■
Text styles	Bold, italic, bold italic, strike-through, underline	Bold, italic, bold italic, subscript, superscript	Bold, italic, bold italic, strike-through, underline	Bold, italic, bold italic, strike-through, underline	Bold, italic, bold italic	Bold, italic, bold italic, underline
Page Layout						
Assign background pages/foreground pages	☐☐	■■	☐☐	■■	☐☐	■■
Create page templates	☐	■	■	■	■	■
Edit backgrounds	N/A	■	☐	■	■	■
Set page display options	■	■	■	■	■	■
Work in layers	■	■	■	☐	☐	■
Database Characteristics						
Link data to graphic element	☐	■	☐	☐	☐	☐
Maximum number of fields	N/A	1	N/A	N/A	N/A	4
Maximum number of characters per field	N/A	32	N/A	N/A	N/A	63
Add notes to a field	N/A	■	N/A	N/A	N/A	☐
Suppress printing of a field	N/A	■	N/A	N/A	N/A	■
File Formats						
Import	.BMP (via Windows Clipboard only), .WMF	.BMP, CMG, .DRW, .EPS, HPGL, PCX, TIFF, .TXT .WMF	.BMP, .WMF	.DSP (proprietary), .TXT, .WMF	.BMP (via Windows Clipboard only), .WMF	.BMP/.DIB, CGM, .DXF, Mac Pict, .PCX, TIFF
Export	.WMF	EPS, .WMF	Via Windows Clipboard	.BMP, .WMF	.BMP, .WMF	.BMP/.DIB, CGM, .DXF, Mac Pict, .PCX, TIFF
Printing Options						
Automatically fit to page	■	■	■	■	■	■
Set margins	■	■	☐	■	■	■
Tile across pages	■	■	■	■	■	■
Documentation and Support						
Technical support hours (eastern time)	8:00–6:00 M–F	11:00–8:00 M–F	9:00–5:00 M–F	9:00–5:00 M–F (toll-free)	24 hrs. M–F; 8:00–5:00 Sat., Sun. (toll-free)	9:00–8:00 M–F
Tutorial	■	■	■	■	■	■
BBS	None	None	None	Internet	America Online, CIS	CIS

N/A—Not applicable: The product does not have this feature.

Gilford, NH 03246; 800-745-6095. List price: *$199.*

Circle 471 on reader service card

Chartist-2, Version 2.04, *Novagraph Inc., P.O. Box 850115, Richardson, TX 75085; 214-231-2169.* List price: *$125.*

Circle 472 on reader service card

MetaDesign for Windows, Version 4.0 *Meta Software Corp., 125 Cambridge Park Drive, Cambridge, MA 02140; 800-227-4106.* List price: *$350.*

Circle 473 on reader service card

Aldus IntelliDraw, Version 1.0, *Aldus Corp., 411 First Ave. South, Seattle, WA 98104; 619-558-6000.* List price: *$199.*

Circle 474 on reader service card

SnapGrafx, Version 1.0, *Micrografx Inc., 1303 Arapaho, Richardson, TX 75081; 800-733-3729.* List price: *$295 ($99 until December 31).*

Circle 475 on reader service card

EDITORS' CHOICE ▶ Visio, Version 1.0, *Shapeware Corp., 1601 Fifth Avenue, #800, Seattle, WA 98101; 800-446-3335.* List price: *$299, ($129 until Dec. 31).*

Circle 476 on reader service card

Intel Technology Briefing



Performance Measurement

True Tests Of Speed

PUTTING PCS TO THE TEST.

At Intel, we've become experts at measuring PC performance. The reason for this is quite simple. We need ways to accurately measure performance in order for our engineers to develop faster processors. That's why we've worked with other companies in the industry to develop measurement tools. You can use these same tools to choose the right PC.

MEGAHERTZ. LIKE RPMS?

One common misperception is that you can compare PC performance by comparing megahertz ratings or clock speeds. This is like comparing the performance of engines with RPMs instead of horsepower. For example, although a small 4-cylinder engine may operate at high RPMs, it isn't as powerful as a big V-8 at lower RPMs. That's why the industry created benchmarks.



PERFORMANCE BASICS.

There are four different types of benchmarks. You should be sure you're comparing the same types of benchmarks when comparing PCs. One kind measures the performance of an entire system. Another only measures subsystems.

In addition, benchmarks can be built two different ways—using commercial software applications or synthetically with code that's written to represent applications. While most applications are several megabytes in size, some synthetic benchmarks are only a few kilobytes. This allows them to fit in internal processor caches. So they exaggerate processor performance and don't reflect real-world results.

SYSTEM BENCHMARKS.

To compare the performance of an entire computer, you should use a system benchmark. This type of benchmark demonstrates how the individual subsystems in a PC work together to achieve overall performance for your applications.

One example of a benchmark that does this accurately is BAPCo's SYSmark93* for Windows.* It's an applications-based benchmark made up of best-selling Windows applications including word processing, spreadsheets, databases, software development, graphics and desktop publishing.

BAPCo is a non-profit organization comprised of 21 hardware and software member companies throughout the industry, including Intel. To ensure real-world performance results, BAPCo surveyed users about how they are actually using these applications and incorporated these results into their benchmarks. (See the charts on back.)

SUBSYSTEM BENCHMARKS.

These benchmarks stress a single aspect of a PC's performance. They help manufacturers "tune" each subsystem in a PC to work together and achieve the fastest overall speed. Viewed alone, however, they are not an accurate measure of how a computer will perform overall.

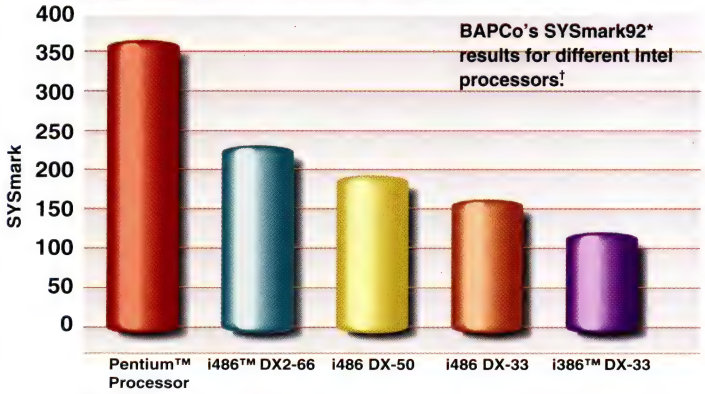
Because the microprocessor is the subsystem most responsible for a PC's performance, you should choose it first using a tool like the iCOMP™ index. The other subsystems should then be chosen based upon your software's needs. (See the diagram this page.)





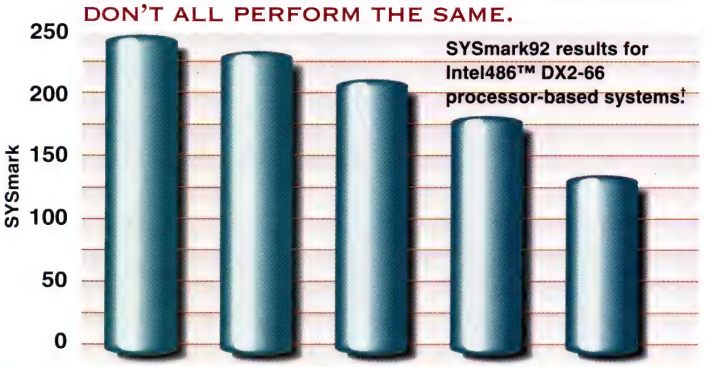
System Performance

In general, the faster the processor, the faster the computer...



As you can see, these bus system benchmark results are similar to the iCOMP™ index results inside. This shows how the iCOMP index can be used to easily compare the performance of computers with different processors.

However, PCs with the same processor don't all perform the same.



All Intel486™ DX2-66 processor-based systems.
†Source: BAPCo's SYSmark92 complete report.

The overall performance of a PC depends upon the entire system—not just the microprocessor. That's why it's important to choose a PC with well-tuned subsystems.

Not all PCs are created equal.

It has been said that a chain is only as strong as its weakest link. Although the processor is the vital component in a computer, other subsystems can have a dramatic effect on overall performance. In fact, depending upon subsystems like disks, memory and video, the performance of PCs with the same processor can vary by up to 100 percent. Even with the same components, system performance can be enhanced through disk caching software and BIOS enhancements.

Subsystems should be chosen based upon your software:

- Video—Better video subsystems will boost the performance of Windows and graphic-intensive applications.
- Disk—Faster disk drives will boost the performance of applications like databases.
- Memory—A better memory subsystem, a more efficient cache and faster RAM speed increases the performance of all applications, especially calculation-intensive ones like spreadsheets.

For more information on the iCOMP™ index and performance measurement, call 1-800-955-5599.

We've prepared a detailed package including more information on the iCOMP index, the different kinds of benchmarks, and even specific benchmark results. Simply call us today and ask for literature pack #73. We'll send it all to you absolutely free.

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SUBSYSTEM PERFORMANCE

How to measure the speed of the subsystems in a PC.

Video

Video performance is determined by the graphics chip set and whether or not it's on a local bus. Ziff Davis Labs' Winmark test is a good measure of this PC subsystem.

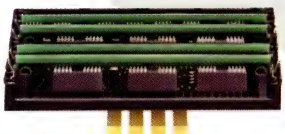
Memory Subsystem

Memory performance is dependent on cache size and architecture which determine wait states. Because it is linked to the microprocessor, it is best measured by a good CPU benchmark like SPECint92, Landmark 3.0 or ZD Labs' PC Bench 7.

Disk Drives

Many of today's hard disks incorporate disk caches which increase throughput. You can simply compare access times or use most PC utility programs to accurately test disk drive performance.







Bus

The ability to transfer information quickly between the processor and other subsystems is vital to overall system performance. This is measured by bus throughput. Advanced buses like the PCI bus can transfer information at 132MB/sec as compared to 5MB/sec for the ISA bus.



Composition

The iCOMP index is a weighted average of several well-accepted industry-standard benchmarks, each measuring a specific aspect of processor performance.

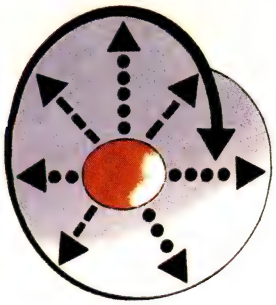
The iCOMP™ index. Comparing Intel Microprocessors.

Megahertz ratings are not an accurate measure of microprocessor performance. Other elements have an effect on speed. For example, an Intel486™ processor has larger caches, floating point operations and the ability to execute one instruction in a single clock cycle. These advancements make it run faster than an Intel386™ processor. Even if both processors are running at 33MHz.

That's why Intel developed the iCOMP™ index. It's an easy, reliable way to compare the relative performance of Intel processors.

iCOMP stands for the Intel COmparative Microprocessor Performance index. It is not an industry benchmark. Rather, it's an Intel-developed tool for comparing the performance of our microprocessors.

The iCOMP index represents Intel processor performance on typical desktop applications, saving you the time of reading and understanding multiple benchmarks. Plus, it's "forward looking." It weighs 16-bit performance 70 percent and 32-bit performance 30 percent. Thus, it represents typical usage during the next three to five years.



Flowcharting & Organization Charting

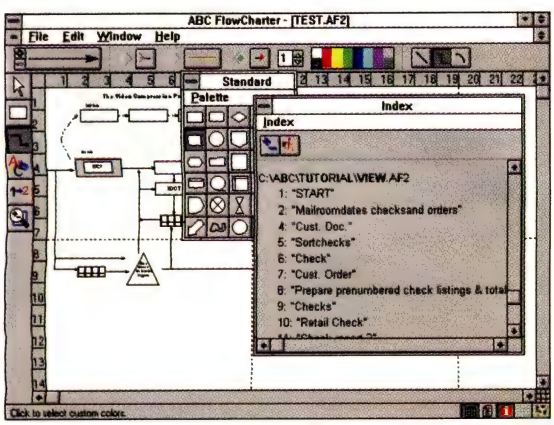
by John Moore and Stephen W. Plain

Trying to differentiate between flowcharts and organization charts can be like trying to tell twins apart. In that both convey information via a series of symbols and connectors, the resemblances between the two can be amazing. Where they differ is in the type of information they're used to convey. Where flowcharts depict a process, whether it's the steps you have to take to program your VCR or the many stages of manufacturing a motherboard, organization charts depict hierarchical structures, such as whom you report to in the corporate environment.

While multipurpose diagramming tools offer something for everyone, these dedicated charters offer tools that are geared specifically toward a single type of charting task. Many of these packages are capable of creating both flowcharts and organization charts if you're willing to be flexible. Kaetron Software's FlowChart Express for Windows ($149) shipped too late to be eligible for this review, but the package should be available by the time you read this.

ABC FlowCharter, Version 2.0, from Micrografx, is one of only two products currently available for Microsoft Windows, and it clearly distinguishes itself from the other Windows products by providing the most intuitive interface and perhaps the broadest set of features. However, its $495 price tag is the highest of the bunch.

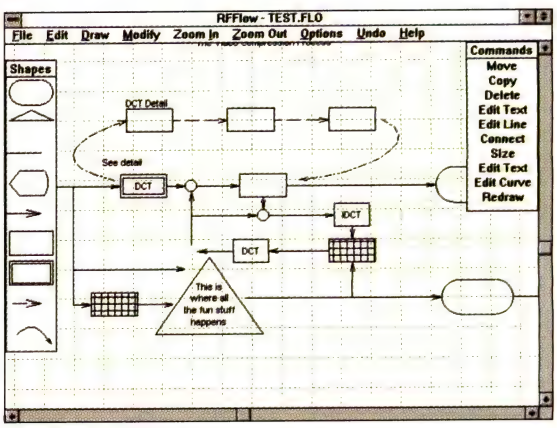
ABC FlowCharter sports a well-designed user interface that takes advantage of Windows' point-and-click nature to make building flowcharts less time-consuming and less confusing. A vertical toolbar on the left side of the main design window contains icons for the product's six basic tools: the pointer tool, shape tool, line tool, text tool, object numbering tool, and magnifying glass. As each is clicked, a toolbar along the top of the window changes to display preference controls applicable to the selected tool, such as border style, fill pattern, shadowing style, color, and other attributes—an approach that makes designing flowcharts a much quicker process than in most other applications.



ABC FlowCharter maintains an index of objects that allows you to locate a shape in any chart.

ABC FlowCharter includes more than 300 shapes—the widest selection of any flowcharting program—organized into 14 different shape palettes. Among the palettes included are Office, Mini/Mainframe Networks, PC, Schematics, and ISO 9000 Quality Management. You can create shapes in a drawing program then paste them into a chart via the Windows Clipboard. But perhaps more importantly, ABC allows you to create large drawings: You can work in paper sizes up to 17- by 22-inches, tiling as many pages as you need.

One of the essential features of any flowcharting package is a ruler to which you "snap" the shapes to help you neatly line them up. In ABC FlowCharter, you align shapes to the rulers and choose coarse or fine settings, or you can turn off the rulers all together. Another feature common to these programs is the alignment guideline, which is a user-defined line that attracts objects like a magnet to wherever it's placed. ABC FlowCharter offers two settings for this attraction as well: weak and strong.



The alignment grid in RFFlow can be displayed as a matrix of lines, points, or x,y coordinates.

FlowCharter's mechanism for drawing lines to connect shapes is equally as important as its set of shapes. This step is often the most frustrating part of creating a flowchart, but ABC FlowCharter makes the process about as easy as it can be. ABC FlowCharter allows you to draw three types of lines: direct, curved, and right-angled. Connecting two objects with a line is as simple as selecting the line tool and clicking inside the objects.

ABC FlowCharter can act as an OLE server, giving you the ability to link or embed a flowchart into a word processing document and edit it without leaving that program. In addition to linking shapes with other charts, you can make

the shapes launch external applications when double-clicked. This can be a valuable asset in situations in which the flowchart is being used interactively and data contained in other documents needs to be looked at during a particular step. Micrografx plans to release a runtime version of ABC FlowCharter aimed at such interactive applications of the product.

ABC FlowCharter has set a new standard for flowcharting software. Its wisely designed interface provides the most productive way to work. Though it's more expensive than the other products we tested, ABC FlowCharter is the best choice for those who make heavy use of such a program.

RFFlow, Version 2.08, from RFF Electronics, another Windows flowcharting package priced at $129, is a less expensive alternative to ABC FlowCharter with a more limited feature set. Despite this limitation, it can be a suitable tool for the occasional user who wants to create the simplest of flowcharts.

RFFlow's interface operates a little differently than the interfaces of most Windows applications. Like ABC FlowCharter's interface, it includes a shape toolbox, but it also features a toolbox for commands. The command toolbox holds commonly used functions defined by the user, such as Size Object, Edit Text/Shape, and Connect Objects. The shape toolbox holds line and text styles as well as the shapes themselves. You designate the shapes and commands that will appear in the toolboxes via menus, although the toolboxes don't really hold enough information in them. The shape toolbox can only hold up to 9 shapes, and although there are 13 available commands, there are only 10 spots in the command toolbox.

To place a shape in RFFlow, you first click on the shape you want (or select one that is not in the toolbox through the menus), then type the text you want in a dialog box. After entering the text, you can click where you want the shape to be placed. Although this feature streamlines the process of placing shapes with text, the shape automatically sizes to the length of the text. This makes it difficult to create shapes of equivalent sizes.

A Different Approach

by Gayle C. Ehrenman

For those who think in terms of content instead of form, the DOS-based allClear, Version 1.2 ($299; from Clear Software, 800-338-1759) offers a unique approach to the creation of connection-based diagrams. Instead of working with symbols, this package works with words. You simply write a description of the process you want charted, and the software generates the diagram.

The package uses standard English for scripting, taking its cues from the punctuation marks at the end of your written phrases. For example, a period at the end of a line represents a single step in a procedure, a question mark is interpreted as a yes/no option, and a colon indicates a multiple choice. You can use the internal word processor, or import a document.

When you've finished writing your script, the package analyzes the script file and produces the diagram using the parameters you've specified in a style sheet. If you need to change the information in the diagram, you toggle back to the script file; to change the look of the flowchart, orgchart, or decision tree, you go back to the style sheet.

The need to toggle back and forth between views can get a bit frustrating, but a $299 Windows version of the package, which should be available by the time you read this, will eliminate this problem by adding split-screen viewing, so you can edit your script and see the changes in the diagram immediately. It will also offer greater font and customization options so you can quickly and easily create more highly stylized diagrams. □

You define lines the same way you define shapes. Curved lines are shaped in a similar manner as in ABC FlowCharter: You define the two endpoints of the line as well as two points on the starting and ending tangents of the line to adjust the curve—a method that greatly simplifies the task of making curves go where you want them to go.

One of the nicest features in RFFlow is its zooming capability. The Zoom In and Zoom Out menu items help you smoothly adjust your vantage point of the flowchart. Another interesting element is the package's use of the right mouse key to move the flowchart image: Holding down the right mouse button while moving the mouse will adjust the chart image relative to your perspective, much as you would put your finger on a piece of paper and slide it into a new position.

As we went to press, RFF Electronics was readying a major new release of the RFFlow package. In addition to rectifying the small toolbox problem, it will add some powerful new features, including a shape editor to create custom shapes, OLE server capabilities, and bitmap and metafile import support. Although the current version of the program is no match for ABC FlowCharter in terms of features, the upcoming release may offer a valid alternative to Micrografx's powerhouse.

Flow Charting 3, Version 2.11, from Patton & Patton Software is the real veteran in DOS-based flowcharting and is competitively priced at $250. The best established flowcharting packages still exist solely in the DOS world. Their charting environments are no match for the flexible Windows interface, but they are much less expensive than ABC FlowCharter. First introduced in 1982, Flow Charting 3 is a firmly entrenched program in its field, but it lacks flexibility in a few key areas.

Flow Charting 3 can be used with or without a mouse with about the same degree of ease, but the package includes only 35 shapes—a surprisingly small selection given the age of the product (Patton & Patton, however, runs a BBS from which users can download additional shapes). The built-in shapes each have a


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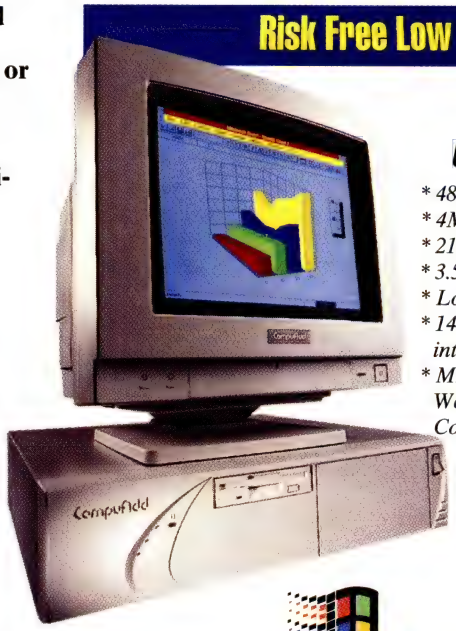
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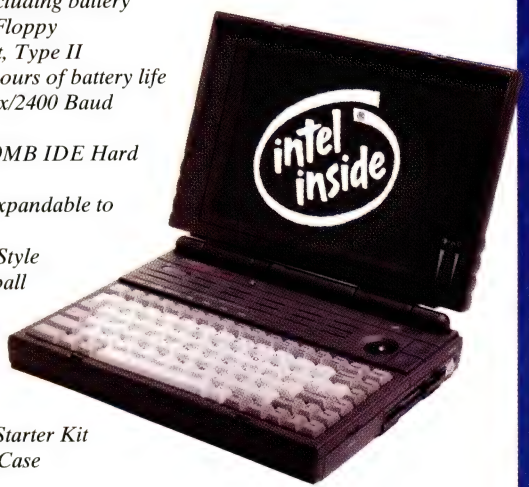
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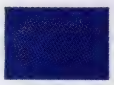
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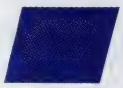
Glossary of Flowchart Symbols

You learned in grade school that a square is a square and a circle is a circle. In the corporate world, however, shapes aren't quite that simple. Flowchart symbols denote different processes and actions depending on your line of work. Adding to the confusion is the fact that your company or organization probably has its own standard set of symbols and definitions for each. But that's the beauty of a flowchart: You can create shapes and give them whatever meanings you want. With that in mind, here is a visual glossary of the most commonly used flowchart shapes and their generally accepted meanings.

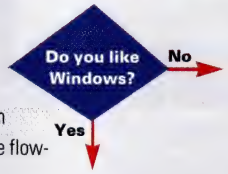
process Usually indicates an operation, a group of operations, or an object on which an action is taken.



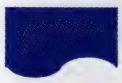
input/output Stands for the process of inputting data or the result of processed data.



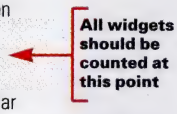
decision Typically indicates a yes/no decision, which helps the viewer decide in which direction to proceed on the flowchart.



document Usually represents printed output or hard copy, such as printed invoices or purchase orders, readable by people (as opposed to machines).



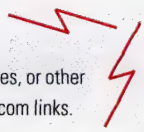
annotation Used in conjunction with connector lines and text. This symbol further clarifies, describes, or explains a particular symbol or what is occurring in a symbol, or adds further information to help the viewer understand a process.



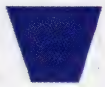
connector Indicates an entry to or exit from another portion of a chart. It is typically used together with a letter or number, which tells the viewer where to go next.



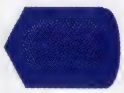
communication links Often used in WAN diagrams; used to indicate phone lines, modems, cables, or other means of transmitting data via telecom links.



manual operation Indicates a process performed by a person, as opposed to one performed by a machine.



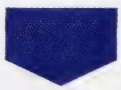
display Represents information displayed on a video source such as a monitor or touch screen.



extract and merge Used to indicate, respectively, the removal and combination of items or sets of items; often loosely used to represent decisions.



off-page connector Used on any side of a chart; indicates that the chart continues on another page. It often contains a number that tells you where to go next.



finite set of sizes (up to 12, depending on the shape); other sizes of particular shapes must be created through image files.

Unlike most other flowcharting packages, Flow Charting 3 does not treat shapes and lines as individual objects. As a result, an error in routing a line can write over a previously defined shape (although a feature called Fast Key mode prevents a line from crossing through shapes, text, or another line). This also means a shape can not be directly resized once it is in place (though there is an X-ray mode on which you can drop a larger shape).

Flow Charting 3 suffers from some limitations, but a Windows version of the product is in the works, which is expected to use tool trays of shapes, lines, and text attributes, and which should treat each as an individual object. Support for custom shapes via the Windows Clipboard is also expected to be included.

EasyFlow, Version 8.0, from HavenTree Software is the other established DOS-based flowcharting package in this roundup. It offers a bit more flexibility than Flow Charting 3 and a competitive price of $280. EasyFlow employs more of an object-based approach to developing flowcharts and comes standard with over 150 shapes that make up libraries designed for flowcharts, orgcharts, and data flow diagrams. Many of these shapes are simply the same shape in a variety of sizes, however. Objects snap to an invisible grid in the Chart Editor that can be adjusted to any desired horizontal and vertical intervals. This approach makes the alignment and manipulation of objects much easier than the character-oriented drawing style used in Flow Charting 3.

EasyFlow boasts a unique feature not included in the other products reviewed here: a Shape Editor, with which you can easily draw new shapes or modify the ones supplied with the package. The Shape Editor also allows you to draw lines and arcs, and define where the text should be placed within the shape. The shapes are organized in libraries that you can set up for different types of drawings or for different users.

Placing shapes in EasyFlow is straightforward, but there's no way to resize a shape—different sizes must be defined as separate shapes. Furthermore, although there is an option for entering a chart title, the title doesn't display until you print the diagram, which can lead to unwanted surprises.

You can use the mouse to draw connecting lines easily between objects; lines have similar customization options to those of Flow Charting 3. EasyFlow bests Flow Charting 3 when it comes to rerouting lines and shapes as a unit. Because EasyFlow deals with the shapes and lines as objects, it knows when a line and a shape are connected and must move together. An automatic rerouting feature in EasyFlow not only moves the lines but ensures that they don't cross in front of or behind any shapes that may be in the way.

EasyFlow provides more flexibility and more sophisticated features than Flow Charting 3 at a similar price, but it falls short of the ease of use found in ABC FlowCharter. If your platform must be DOS and your flowcharts are very large, however, EasyFlow is the right choice. HavenTree is also readying a Windows version of EasyFlow, slated for release in 1994.

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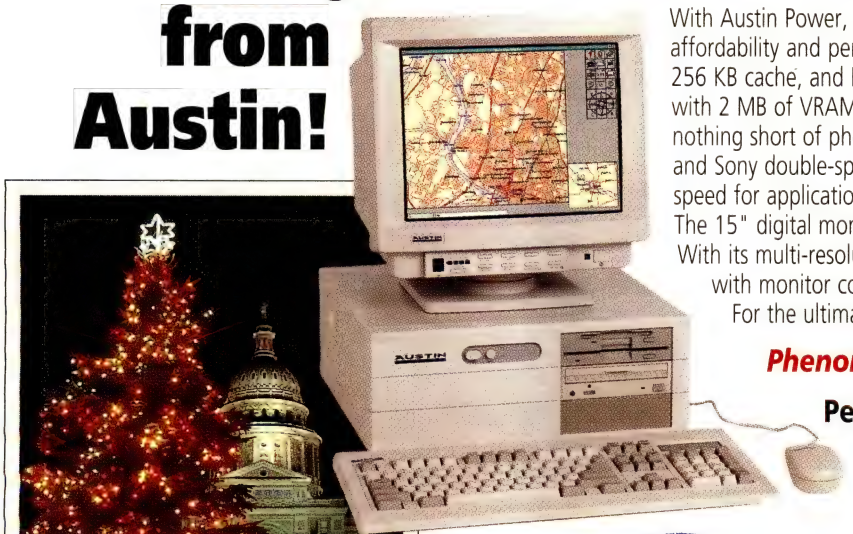
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TurboFlow, Version 3.1a, from Daytron Electronics is the least expensive of all the flowcharters in this roundup, with a price of $69. This DOS-based product doesn't come with a particularly user-friendly interface, but it does offer a few interesting features. TurboFlow sports 32 standard shapes and has an easy-to-use mechanism for creating the all-too-elusive curved line. This product actually lets you scale your objects smoothly to different sizes—something neither Flow Charting 3 nor EasyFlow does. While TurboFlow is not as polished a program as the other flowcharters, it provides basic functionality at an exceptionally low price.

Org Plus for Windows, Version 2.0 ($199.95), from Banner Blue Software assumes that people aren't orgchart experts. It's a strategy that works. The interface takes nothing for granted by featuring a toolbar full of buttons representing the most common positions in an organization: You simply click to create cells for subordinates, a manager, an assistant, and two coworkers.

To create a new chart, you enter the name, title, and any other information you want in the topmost (manager) cell. Any text formats you apply in this cell will be applied globally to all the cells—a feature that saved a lot of time in creating our test chart, in which each title had to be italicized.

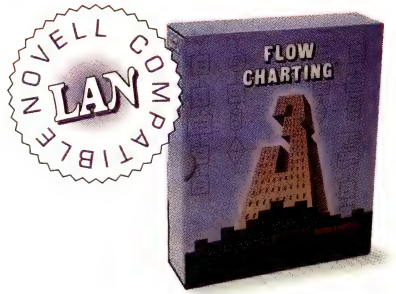
Although you are limited to the program's preset box styles, Org Plus does offer considerable flexibility in how you can position the boxes on a chart. Once you've created your basic layout, you can then modify different sections through the Styles menu, which offers 20 group styles, 8 assistant styles, and 1 comanager style. These choices then give you the ability to mix diverse layouts within a chart.

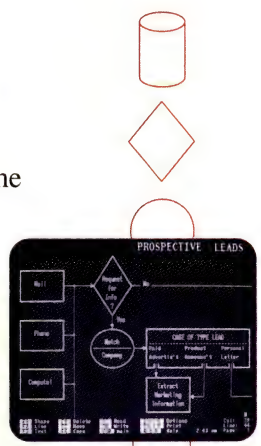
Org Plus is a solid and easy-to-learn package that comes with enough options to allow you to arrange your charts to your liking.

Rearranging branch layouts takes a bit of ingenuity. Although Org Plus's interface simplifies choosing the types of connectors you want, the connectors don't always wind up where you think they will when creating multiple levels. Experimenting with different group styles, however, is still a better option than starting from scratch.

Banner Blue Software's Org Plus is a solid and easy-to-learn package with enough options to allow you to arrange your charts to your liking. Modifying your charts can sometimes be a bit of a chore, but more often than not, you will find that Org Plus satisfies your needs.

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Windows OrgChart, Version 2.0, from Micrografx, like Banner Blue's Org Plus for Windows, proves that simplicity doesn't have to come at the expense of functionality. This $149 package is as simple to learn as Org Plus and offers even more flexibility in some areas, although it takes a slightly different approach.

You begin with a cell surrounded by five Add Box icons. Unlike Org Plus, you're not explicitly told what the relationships of these boxes are to one other, so it doesn't hurt if you are somewhat familiar with the basic structure of orgcharts. Because the icons are positioned where they will fall in the finished chart, however, you know exactly where each connector will appear, taking much of the guesswork out of creating a standard tree structure.

One of the package's smartest features is the use of the right mouse button to toggle between the Add Box and the Manual Selector icons, which was very helpful in editing our test orgchart. Once you've chosen the Manual Selector, you simply drag the box to its new position, and if you don't like the change, you can select the Options/Remove Manual Changes command to undo your modifications. The lone disappointment is OrgChart's inability to insert free-floating images—all photos or graphics must be inserted in a cell. Thus, we were unable to paste the company logo at the top of our test chart (the package doesn't support .PCX files, either). This isn't a major flaw, but it does slightly limit your creativity.

With its smart interface and simple editing capabilities, OrgChart is an ideal package for creating and modifying large charts. It helps to have a basic knowledge of orgcharts, but once you get started, even beginners will find it easy to use. □

▶FACT FILE

EDITORS CHOICE ▶ABC FlowCharter, Version 2.0, *Micrografx Inc., 1303 Arapaho, Richardson, TX 75081; 800-733-3729.* List price: *$495.*

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EasyFlow, Version 8.0, *HavenTree Software Ltd., P.O. Box 470, Fineview, NY 13640; 800-267-0668.* List price: *$280.*

Circle 465 on reader service card

Flow Charting 3, Version 2.11, *Patton & Patton Software Corp., 485 Cochrane Circle, Morgan Hill, CA 95037; 800-525-0082.* List price: *$250.*

Circle 466 on reader service card

Org Plus for Windows, Version 2.0, *Banner Blue Software, P.O. Box 7865, Fremont, CA 94537; 510-794-6850.* List price: *$199.95.*

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RFFlow, Version 2.08, *RFF Electronics, 1053 Banyan Ct., Loveland, CO 80538; 303-663-5767.* List Price: *$129.*

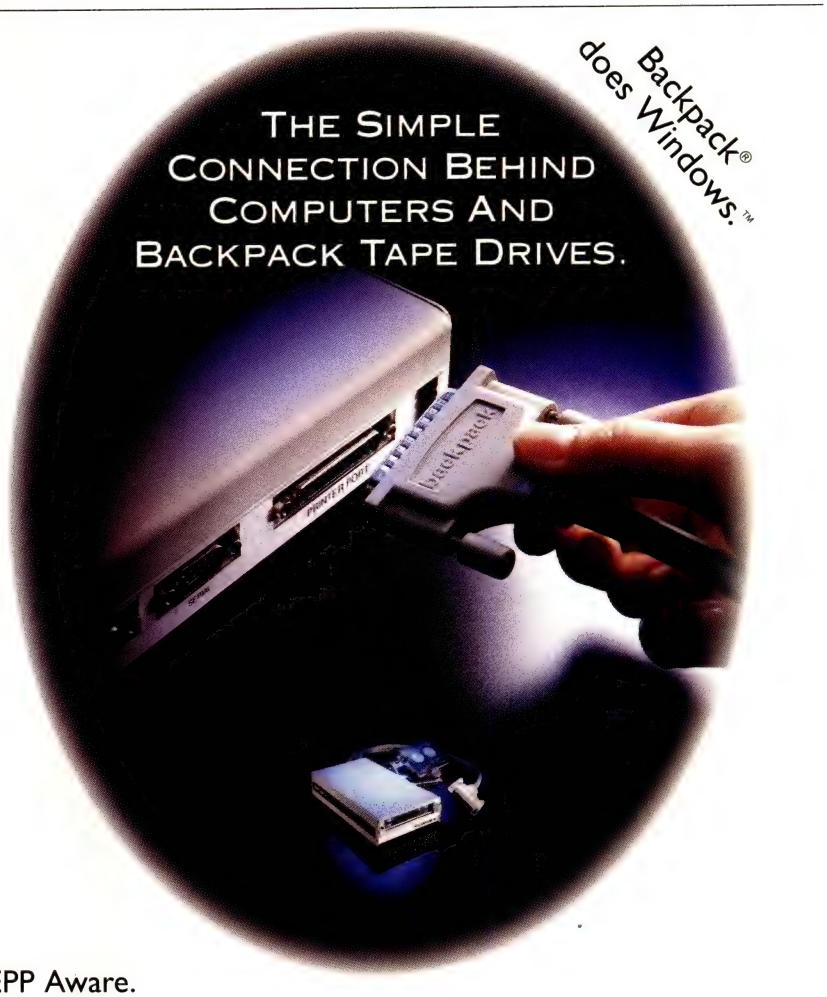
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TurboFlow, Version 3.1a, *Daytron Electronics Inc., 17726 NE 104 Way, Redmond, WA 98052; 206-883-8742.* List price: *$69.*

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PORTABLE TECHNOLOGY

Color Goes Mainstream



by Joel Dreyfuss

The advent of high-quality, inexpensive color screens makes Windows more manageable on the road. The 33 notebook PCs reviewed here open the world of color to travelers.

Are monochrome notebooks dead? Not just yet, but color notebooks are becoming so inexpensive and so good that if you're in the market for a laptop, you ought to take a close look at the latest crop of color machines.

It wasn't so long ago that *color portable* was an oxymoron: Such units weighed more than 20 pounds and could barely last an hour away from an AC plug. That's all changed—and soon there may be a color system on every lap.

This roundup of 33 486-based color notebooks shows that portable color systems have slimmed down and are on the verge of becoming mainstream, not merely the expensive alternative for your boss's boss. We found color notebooks

Illustration by David Kahl

for as little as $2,380, color notebooks whose high-quality displays make an external monitor unnecessary, and color notebooks with the ability to run for at least 5 hours on a single charge.

True, the best color notebooks are still expensive compared to their monochrome brethren, but there are many sound choices.

SWIFT COLOR SHIFT

Just two years ago, *PC Magazine* considered color on a notebook a hard-to-justify luxury for the traveling executive; last year we conceded it was a pricey but increasingly attractive option; this year it has become the new notebook standard.

The reason? Compaq, IBM, NEC, and Toshiba—four of the biggest players in the portable-PC market—expect to sell more color notebooks than monochrome ones in the coming year. The driving force is dual-scan color, a technology that delivers color on passive-matrix LCD screens that's almost as good as the image quality offered by the more expensive active-matrix screens (see display technology sidebar).

Active-matrix is still the best and brightest, as demonstrated by the IBM ThinkPad 750C, the NEC UltraLite Versa 33C, the Compaq LTE Lite 4/33C, and others in this survey. But active-matrix screens, whose designs approach the complexity of a 386 processor, remain incredibly difficult to manufacture. One defect among the hundreds of thousands of active electronic elements that control the display can render a screen unusable. Low factory yields keep prices high and have opened the door to alternative technologies.

Another factor contributing to the growing popularity of laptop color is the fact that computer users have come to take color for granted; few use a monochrome screen with their desktop PCs. Switching to a laptop that runs Windows or OS/2 in shades of gray is a lot more jarring now than it was when you spent most of your time staring at text on a green screen.

As laptop makers narrow the compromises between desktop and notebook PCs, users are less willing to give up *anything* when they go out the door with that 7- or 8-pound machine.

Computer makers are responding to the new demands for color; most are either shipping color laptops or working to get them out the door. Such a sea change in the already-turbulent world of computing is bound to juggle the standings, and we already see evidence of that shift.

The most significant new player in the color-notebook market is IBM, whose robust ThinkPad 700 series has shouldered aside Apple's PowerBook to become the most sought-after notebook computer. Color has also given new life to NEC, which won a *PC Magazine* Award for Technical Excellence in 1988 for its pioneering 4-pound UltraLite and then promptly dropped out of contention. NEC has come back strong with the Versa 33C, a fast and powerful entry that, despite the use of the "U" word, weighs more than 8 pounds.

There's a fresh crop of newcomers as well. The laptop marketed by Broadax Systems and FutureTech Systems blazed to the top of our benchmark tests by using VESA local-bus technology. Panasonic, which never fathomed the U.S. desktop market, makes a strong bid for recognition with its CF-580C. Digital, a notebook novice, has made an impressive showing with its DECpc 425SLC, which is made by AST Research. But the strongest showing

PC MAGAZINE

EDITORS' CHOICE

- **IBM ThinkPad 750C**

The world of notebook computing spins so rapidly that it's hard to keep up—especially since so many products are replaced semiannually. Just a year ago, 386 monochrome systems ruled. Today, we're seeing a variety of 486-based color systems, and they are rapidly becoming the standard for computing on the road.

A dual-scan passive-matrix display is seen as the key to resolving the inevitable conflicts between quality color and good battery life. At the same time, the best active-matrix color notebooks just keep getting better, offering more functionality and near-desktop performance.

Our Editors' Choice selection process involved criteria that was deceptively simple. We looked for more than 3 hours of battery life; at least one PCMCIA expansion slot; and reasonable, evenhanded performance—all packaged in a lightweight design. There were several honorable mention recipients that failed in one

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category or another. Chief among them were Texas Instruments' three TravelMate portables, which push processing to new highs while going easy on battery life but still lack PCMCIA slots. The passive-matrix ZDS Z-Note 425Lnp+ marks the beginning of a generation of real-world notebooks that can achieve 5 hours of battery life, but it posted the lowest disk scores in this roundup. And rather than being a leader in making more fit into smaller and lighter packages, Toshiba America Information Systems is offering the Toshiba T4600C, which, unfortunately, looks bulky and overweight by today's standards. The release of a color subnotebook will likely remedy this situation and allow Toshiba to again set the pace.

When it comes to full-size color, the 7.8-pound active-matrix color IBM ThinkPad 750C is the latest in a long line of winners from IBM Personal Computer Co. It remains a notebook of firsts and onlys: the first and only notebook with a 10.4-inch color display, the only notebook to include the point-and-click TrackPoint II mouse substitute, and the only notebook to incorporate a sound chip. Add all that to its membership in the select group of systems that can last 3½ hours between charges and you have a sure winner.

We can only fault the 750C on two points: the trouble buyers have had in getting their hands on one lately, and its price, which at $4,699 is relatively expensive. We feel, however, that this exceptional product is worth the extra money.

for a recent addition into the color-portable market goes to Acer America Corp.'s AcerNote portables. Designed from scratch for ease of use and power, they are a good compromise between price and performance. The traditional laptop powerhouses have not folded their tents before the onslaught of *arrivistes.*

- Texas Instruments, which won accolades and an Editors' Choice award for the TravelMate 4000 line in our August 1993 issue, scores again with its powerful, well designed machines, even though these machines lack PCMCIA sockets.
- Toshiba, with its T4400C, showed that it understood the world is more than black-and-white and makes a respectable showing this time around with its new high-end active-matrix T4600C and the well designed, less expensive Satellite T1900C.
- Compaq badly needs to freshen up its notebook lines, but the color versions of the Lite and Contura series remain respectable players despite the company's aversion to PCMCIA slots.

WALKING THE TIGHT ROPE

The complexity of the technologies and decisions involved in creating a color laptop guarantees that this category of products is not likely to be labeled a commodity anytime soon. Participating in this market is like walking a tightrope without a net: One wrong step can doom an otherwise respectable machine to the free-fall of the remainder catalogs, such as COMB or Damark.

The most visible challenge to any vendor is ergonomics. You have to assume that anyone buying a color notebook plans to run Windows or OS/2. This means that a pointer or mouse replacement is de riguer. IBM's eraser-like TrackPoint II remains our favorite. IBM had $1 billion in back orders for its $5,000 ThinkPad 720C series when it was superseded by the 750C series that is reviewed in these pages. The reason? A supply shortage of 10.4-inch color screens and of the strain gauges used in the keyboard pointer.

It was just a matter of time before TrackPoint II would be cloned, and it will show up on the latest version of Gateway's Handbook 486 and inevitably many others. In the interim, manufacturers are plunking down trackballs just about anywhere on the keyboard or case. Some products, such as Toshiba's and others', show good design: These machines include the Microsoft BallPoint cordless trackball that connects to the notebook body through a snap-in plug.

But there are pitfalls. No notebooks to date can accept the snap-in trackball on either side of the notebook, accommodating both righties and lefties. On the other hand, CAF Technology may have carved itself a market niche with its AquaLITE notebooks, which have trackballs for left-handed users; yet, in catering to southpaws, CAF risks alienating the remaining 90 percent of the market.

Many vendors, such as AST, Compudyne Products, and ZEOS International Inc., to name a few, provide trackballs that are too small; others, such as Commax Technologies and Panasonic, poorly place the actuation buttons. Trying to find a home for the pointer can also lead to some cramped keyboards. The most prominent offender in this regard is the HyperBook series from HyperData Technology Corp., which, in order to integrate a numeric keypad, sacrifices the rest of the keyboard.

WHAT WERE THEY THINKING?

Then there are design problems that make you wonder what the product managers were thinking. One of the most annoying "features" has got to be the laptop screen that won't stay put once you've found the best angle for it. It's an annoyance if you regularly plug into an external monitor, a major crisis if you fly coach and the guy in front of you decides to tilt his seat back for a snooze.

We've consistently praised companies such as Texas Instruments and Compaq for putting the I/O ports on the sides of your laptop where you can reach them easily, but many companies haven't been listening to us. They keep putting those ports in the back and then covering them with little doors that fall off on your first trip.

If the only issue in these reviews were style, we'd give a "Best Looks" award to HyperData. Most color notebooks offer the rainbow once you turn them on, but the cases range only from light gray to basic black. HyperData's HyperBook shatters the mold, with a gray case that is tastefully

Our Contributors: JOEL DREYFUSS is editor of *PC Magazine.* ROBERT S. ANTHONY is a senior writer, BRAD GRIMES is an assistant editor, ELISABETH HOLZER is a copy editor, and ANUSH YEGYAZARIAN is a senior editorial researcher at *PC Magazine.* GREG PASTRICK, STEPHEN W. PLAIN, and STEVE POTTER are contributors to *PC Magazine.* JEFFREY GREENBERG is a technology writer. BRIAN NADEL was the associate editor in charge of this story, and TAMI PETERSON was the project leader.

highlighted with purple, turquoise, and mauve buttons. This design reminds us of the original AT&T Safari, with its 1930s-radio good looks and turquoise trim. Alas, the Safari delivered by the newly merged AT&T/NCR entity is really a NEC Versa 33C and looks like many a drab gray machine.

RECENT REVIEWS

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- **Multimedia PCs: Sight & Sound**
  October 26, 1993.....page 108
- **Value-Line PCs: Family Values**
  September 28, 1993.....page 116

REVIEW CRITERIA

To be included in this review of color notebooks, vendors had to send us a 486-based portable with a 120MB hard disk and 4MB of RAM, all in a package that's 9 pounds or less. (Weight includes system, battery, and power adapter.) Testing was done in early September and prices are current as of mid-October. The 33 notebook PCs represent a good cross-section of the portable-PC market as it stands today, but several units were shipped too late to be included in these reviews. The most interesting of these is Toshiba's Portégé T-3400, a 4-pound active-matrix system (with a travel weight of 5.8 pounds) that straddles the worlds of notebooks and subnotebooks (see review in First Looks section). Several others are showcased in this roundup; two more are the $2,399 486SX-powered color WinBook from computer super-store Micro Electronics and the Compaq Concerto, which has a detatchable keyboard.

The computer business is one of compromises and challenges. The biggest challenge for manufacturers? Developing and implementing technology that brings the performance of portables as close as possible to the performance of desktop systems. This review of 33 notebooks included 10 different microprocessors. To test the machines, we used our updated PC Bench 8.0, which includes the Winstone 94, Version 1.0, applications test suite. Indicative of the need for PC power among users, five of the machines used full-fledged DX2/66s; four notebooks came with DX/33s, five with SL/33s, and three with Cyrix SLC/33s; two came with DX2/50s, four with SX/25s, seven with SL/25s; one each came with the DX2/40, the SX/33, and the SX/20.

On the average, these notebook computers performed at about 75 percent the power of desktop machines with equivalent CPUs. The Texas Instruments notebooks—well engineered machines that are based on fast memory—were notable exceptions, delivering approximately the same amount of power you would expect from a full-size, CPU-equivalent machine. In fact, the Texas Instruments TravelMate 4000E WinDX2/50 Active Color outperformed even the machines with DX2/66 processors in this review, proving that design and execution is everything in this category. The slowest notebooks were those based on the Cyrix 486SLC/33, which has a 16-bit internal data path and a 1K internal cache, as opposed to the Intel 486DX's 32-bit internal data path and 8K internal cache.

As a high-temperature reality check, we also tested a Dolch Pentium-based luggable system. Weighing nearly 20 pounds, it registered a processor score that was three times the score of the best DX2/66 in our notebook test, which is what we'd expect from a desktop Pentium. Look for it to be available at year's end.

SCREEN SPEEDUP

In an effort to crank up traditionally slow LCD video, a growing number of color-notebook vendors are implementing local-bus video—and to good effect. Four of the top five machines that scored highest on our Graphics Winmark tests used local-bus or proprietary video schemes. Our DOS-video benchmark tests produced a wider spread among the machines tested. The fastest machine (FutureTech's FutureMate) was three times as fast as the slowest, but in real use, you may not notice much difference, because all these machines are slow at running DOS video.

Another important factor in Windows

HIGHLIGHTS

Color Notebooks

COLOR NOTEBOOKS have become so good and so inexpensive that they are rapidly becoming the portable computing standard. Ranging in price from $2,380 to over $6,000, the 33 systems in this roundup represent a good cross section of the market.

THE DISPLAY OF CHOICE remains the active matrix, but some inexpensive dual-scan passive screens offer a good color image for just a little more money than you'd pay for monochrome. In keeping with this trend, Compaq, IBM, NEC, Toshiba, and others expect to sell more color notebooks than monochrome ones for the first time this year.

IBM, a traditional laggard in the area of portability, now leads with its rapidly evolving ThinkPad 700 series. The 750C retains the old 720C's 10.4-inch color screen but adds multimedia capability.

PCMCIA POINTS THE WAY for peripherals on the road. Yet some major vendors, including Compaq and Texas Instruments, don't offer a system with a PCMCIA slot. Other manufacturers, such as Acer America Corp., include PCMCIA options only on high-end systems. Toshiba blazes its own trail with a proprietary slot that's larger than a Type-III one and has room for a pair of phone plugs.

TRACKBALLS GALORE: Most vendors continue to use a trackball as a mouse replacement, with varying degrees of success. Many of these trackballs are awkwardly placed and hard to use, though most get the job done. But IBM's unique TrackPoint II is a winner for Windows on the go, once you get used to the feel of it.



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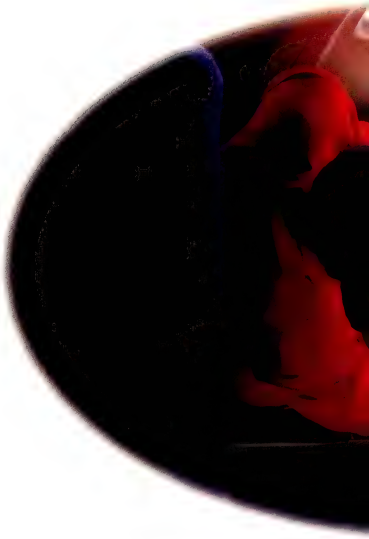


Toshiba continues to drive PCMCIA technology: A 2.01 compliant Type II slot expands your options for storage, fax/modems, networking, and the future.





The new AccuPoint™ isometric pointing device works in conjunction with click and drag buttons located comfortably beneath the thumbs.

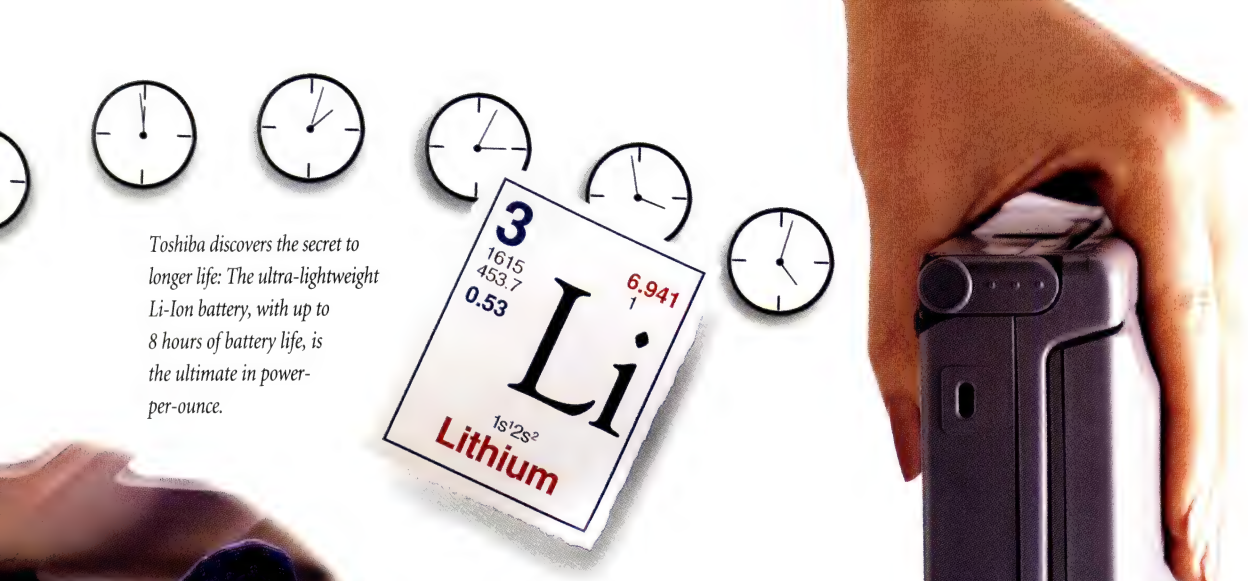


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speed was system memory. Machines based on 8MB or more of RAM performed best. So if you intend to run Windows on your laptop, don't skimp on system memory or you'll pay the performance penalty.

ASSAULT ON BATTERIES

Color laptops have made significant headway in improving battery life, despite the lack of significant advances in battery technology. The units with nickel hydride batteries turned in the best times, with an average time of over 3 hours. Those units powered by nickel cadmium batteries averaged more than 2 hours. But as our tests showed, smart engineering was also a big factor here. Honors for battery-life longevity go to Zenith's ZDS Z-Note 425Lnp+, which lasted for just over 5 hours on a charge. Other factors that determine a unit's battery life are the unit's power-management capability and whether its screen is active- or passive-matrix. As the demand for longer battery life increases, expect to see some new advances in battery technology.

Zinc-air batteries are very promising but will result in bulky—though lightweight—batteries. AER Energy Resources, a leading proponent of battery technology, promises to deliver at least 8 hours of power to the current crop of notebook computers by using an inch-thick slab of cells that fits under the notebook.

The biggest decision you'll make about a color notebook is whether to go with active or passive displays. The greatest determinant in your decision will be price; the LCD screen will probably be the single most expensive component in your notebook. All active-matrix screens now come from Japan, but Dutch electronics giant Philips is hoping to break into the active-matrix market in the near future with a technology that substitutes cheaper diodes for the transistors now etched into glass screens. Until then, there will still be a sharp cost delineation between active-matrix and passive-matrix screens. When you put an active-matrix machine next to a passive-matrix machine, there's no comparison.

The biggest decision you'll make about a color notebook is whether to go with active or passive displays; the greatest determinant in your decision will be price.

Active-matrix is brighter and the colors are richer. But when you view the passive-matrix machine (especially one with the new dual-scan screen) on its own terms, the image is decent—even good. One other important difference between active- and passive-matrix screens: The field of vision is much narrower on the latter. So if you plan to make presentations with your laptop, active-matrix is the way to go.

What else should you consider in choosing a color laptop? The add-ons can kill you. As we've noted in the past, get a good look at the power supply. It can add unexpected weight and bulk to your luggage. Toshiba continues to earn our admiration for the small size of its adapter, which requires only a two-prong outlet. NEC gets the booby prize for shipping one of the largest.

Don't forget the peripherals. We think that credit card–size PCMCIA modems, hard disks, and network cards will continue to help bring notebook size and weight down. Most manufacturers, including Toshiba and IBM, have included them on their most recent products. Compaq and Texas Instruments continue to ignore advances in cards and enabling software. (See accompanying story.) Acer offers a mixed bag: Its active-matrix AcerNote 750C has a Type-III slot and its passive-matrix 730C relies on an internal modem slot. The absence or presence of these slots should influence your buying decision.

Otherwise, mark down one less compromise for road warriors. As we keep saying, you *can* take it with you, and now, in living color.

Suitability to Task: Color Portables

DOS applications reflects a system's ability to run DOS software quickly and efficiently. Excellent systems earned the top DOSmark scores under PC Bench 8.0. The DOSmark formula takes into account processor performance, hard disk agility, and DOS-based video functions.

Windows applications is a more demanding category. The rating indicates how well a system operates Windows software. Factors include Graphics and Disk WinMark scores and the score on our new Winstone test. We also consider hardware, taking into account a system's hard disk options and the diagonal size of its monitor; with Windows, the bigger the better.

The **road warrior** rating indicates how complete a traveling companion a portable is. An excellent unit combines small size, light travel weight, and long battery life. Other factors include screen size, the presence of built-in pointing devices, and PCMCIA slots.

The **desktop replacement** rating is important if the notebook will be your sole computer both at home and on the road. Light weight and long battery life are not as critical, but fast performance is a major consideration. Notebooks that offer docking stations or port replicators earn high marks in this category.

▶ Product Name	
SUITABILITY TO TASK	
DOS applications	POOR
Windows applications	FAIR
Road warrior	GOOD
Desktop replacement	EXCELLENT
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	ABOVE AVERAGE
Technical support	BELOW AVERAGE

SERVICE AND RELIABILITY

In our 1993 Service and Reliability Survey, we sent questionnaires to 17,000 random PC Magazine subscribers; about half responded. Results are given for vendors for which we received an adequate number of responses. Vendors are rated above average, average, or below average in satisfying computer owners' needs.

Reliability indicates whether PC owners felt their systems met their operational expectations.

Repair service results were culled from those who contacted the manufacturers to have PCs repaired.

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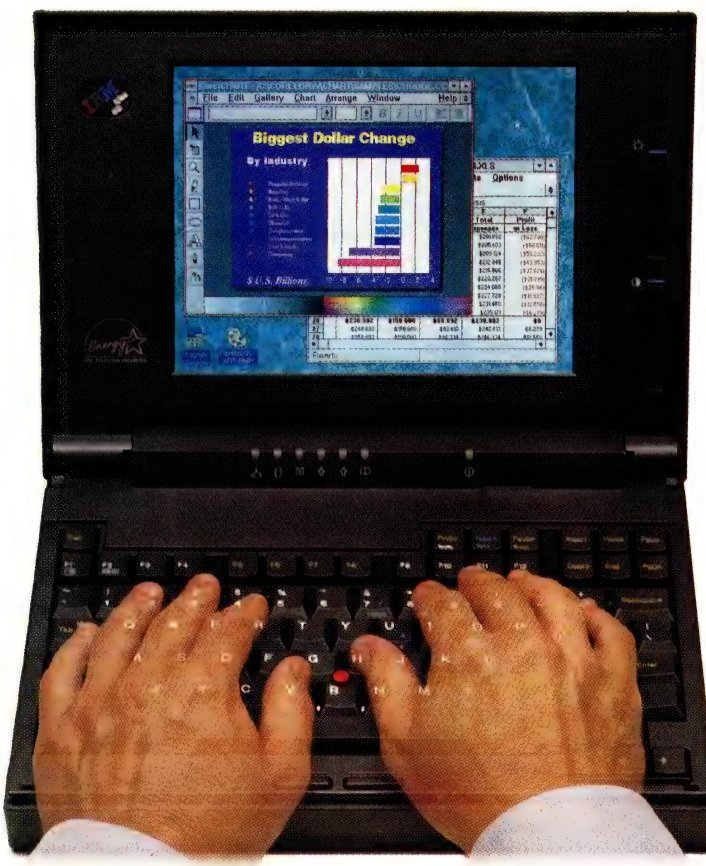
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The advanced power management hardware and software give you a longer battery life. With power management enabled, you can run the monochrome model for up to five hours with the NiMH 2200 MA batteries. And there's no memory effect.

A keyboard with full-size keys—familiar to the touch

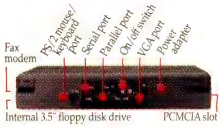
Your IBM notebook features an exceptional, full-size 85-key keyboard with the unique TrackPoint II pointing device. Control cursor movements with ease by moving and varying pressure on the eraser-like button.



intel inside

Monochrome	STN Color
$2199	$2899
• 486 SL/25MHz • 4MB RAM • 170MB HD	• DOS, Windows & more • PCMCIA type II slot • Fax modem included!

Serial, parallel, VGA, and PS/2 mouse/keyboard ports



Convenient payment options

Use your MasterCard, VISA, Discover Card, personal check or P.O. with credit approval.

Satisfaction with your IBM PS/Note™ is unconditionally guaranteed for 30 days from date of purchase. If for any reason whatsoever you are not satisfied with your purchase from us, we want you to return it.

Service, warranty and support

- One-year limited warranty with toll-free Express Maintenance.
- 30-day unconditional money back guarantee.
- On-line technical support for the life of the computer.

Thank you for your order!

Micro Electronics
a division of MEI/Micro Center, Inc.

IBM Specifications

Size/Weight
- 11.7" X 8.3" X 1.9"
- Monochrome: 5.3 lbs. with battery
- Color: 5.8 lbs. with battery

Pointing Device
- TrackPoint II

Battery
- Monochrome: up to 5 hours with power management
- Color: up to 3 hours with power management
- NiMH (no memory effect)
- 2.2 AmpHours
- 110 AC Adapter
- Quick 1-hour recharge when not in use

Advanced Power Management
- Power management hardware and software (nearly transparent to user) for longer battery life
- Automatic and manual suspend/resume button
- Internal variable-rate charging system

Processor and Memory
- Intel 486 SL 25MHz CPU
- 4MB RAM (expandable to 20MB)
- 8k internal cache

Drives
- One built-in 1.44MB 3.5" floppy drive
- Internal 170MB hard drive

Software
- Comes with MS-DOS 6.0, Microsoft Windows 3.1, Microsoft Works for Windows, PRODIGY, America On-line (PS/1 Edition), PS/1 Tutorial, PS/1 Index and PS/1 Fitness.

Display
- 1024 x 768 for external monitor with 512k video RAM
- Monochrome: super-twisted 64 grayscale, 9.5" LCD
- Color: 256 colorscale 9.2" STN color
- Adjustable contrast and brightness

Keyboard
- Full-function keyboard with 85 keys and 4 inverted-T cursor control keys

Modem
- Fax-9600 baud send/4800 baud receive/2400 baud modem

I/O Ports
- Serial, enhanced parallel, VGA, PS/2 keyboard/PS/2 mouse
- PCMCIA 2.0 slot

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Windows at your fingertips

PC MAGAZINE

"Scoring high in overall value and design, the Micro Electronic's WinBook gives you a lot for your money, including an outstanding integral trackball."

PC MAGAZINE, Portable Computing Issue, August, 1993

The WinBook by Micro Electronics™ gives you the power to run Windows and a unique, ergonomic design to make it easier to use.

It features a built-in, centered trackball which allows you to control cursor movements effortlessly without having to lift a single finger off the keyboard. Full-size keys and a sloping hand rest let you work in total comfort.

The new, upgradable, fully-static design SL enhanced Intel486SX 25MHz chip enables the CPU to operate at a 0MHz low power state. The WinBook's Pico Power Evergreen chipset integrates battery and power management with a proprietary, open loop heat regulator circuit to extend battery life and prevent heat build-up. Plus, we have fine-tuned the WinBook's screen. In monochrome and in dual-scan STN color—you get sharper, clearer images with less cursor loss.

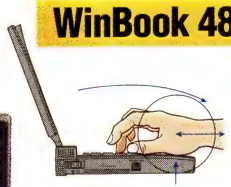
The WinBook was engineered for Micro Electronics, a division of MEI/Micro Center, Inc. MEI is America's leading direct source for computer products. Micro Center has been selling PCs for more than 14 years—longer than IBM or Compaq—with over 736,000 units sold. With over 2.2 million satisfied customers nationwide, we have developed a superior support staff including top engineers and technical specialists. So you always get the highest quality product at the lowest possible price.



WinBook™



WinBook 486 SX SL Enhanced Features



Ergonomically engineered

The WinBook's ergonomic features include a sloping hand rest and keyboard, plus a centered dual-button trackball—allowing you to work in total comfort away from your desk.

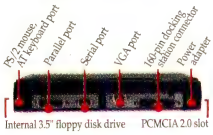
Clean, sharp color display

The WinBook's advanced, dual-scan color display gives you 99% shadow-free performance compared to other single-scan passive matrix displays. You get near active matrix quality at a passive matrix price!

The 5.4 lb. WinBook, designed by award-winning Palo Alto Design

- Includes a 9600 baud send 4800 baud receive fax/2400 baud modem.
- Fast-acting, LCD screen for less cursor loss.
- Industry-standard PCMCIA 2.0 slot for future expandability.
- 512k video RAM.

Mouse/keyboard, parallel, serial & VGA ports plus PCMCIA expansion



Docking station gives you desktop power



With the available docking station, your WinBook instantly becomes a full-function desktop computer. The two expansion slots and drive bays allow you to add peripherals such as monitors, hard drives, CD ROMs, I/O cards or an extended keyboard. It also includes parallel, serial, PS/2 mouse, external keyboard and VGA ports. **And it's just $399!**

Longer battery life

The WinBook features NiMH 2200 MA batteries with gold-plated contacts. This allows it to run much longer than units with traditional NiCAD batteries—and there's no memory effect.

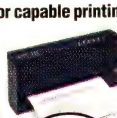
NEW! Intel486 SX SL Enhanced intel inside

Monochrome **$1699** 4MB RAM 200MB HDD
- SL Enhanced Intel 486 SX 25MHz

Dual-Scan Color **$2399** 4MB RAM 200MB HDD
- DOS & Windows
- Fax modem included!

Color capable printing from HP and WinBook

HEWLETT PACKARD



$289

The color capable HP DeskJet 310 uses the same inkjet technology as other DeskJet models and weighs only 4.3 lbs. Get professional quality 300 dpi output anywhere you need it. Add an optional color kit at a special low price and you have full color printing capabilities!

Your satisfaction is unconditionally guaranteed for 30 days from date of purchase. If for any reason whatsoever you are not satisfied with your purchase from us, we want you to return it. We will be glad to repair the product or give you your money back.

Service, warranty and support

- 72-hour service turnaround guarantee.
- 30-day unconditional money-back guarantee.
- 24-hour burn-in protection.
- One-year limited warranty on parts and labor.
- Toll-free technical support for the life of the computer.

Convenient payment options

Use your MasterCard, VISA, Discover Card, personal check or P.O. with credit approval.

Thank you for your order!

Micro Electronics
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Specifications

Size/Weight
- 11" X 8 3/4" X 1 3/4"
- 5.4 lbs. with battery (monochrome)
- 5.9 lbs. with battery (dual-scan color)

Pointing Device
- 16mm Alps dual-action, Microsoft- compatible trackball

Battery
- Up to 3 hours with power management, over 5 hours with auxiliary battery (less 30 minutes for color)
- NiMH (no memory effect)
- 2200 MA with gold-plated contacts
- Worldwide auto-sensing AC adapter
- Quick 1.5-hour recharge

Processor and Memory
- SL enhanced Intel486 SX 25MHz CPU
- 4MB RAM
- Pico Power Evergreen HV chipset
- 8k internal cache

Drives
- One built-in 1.44MB 3.5" floppy drive
- Monochrome: Internal 200MB (16ms) hard drive
- Color: Internal 200MB (16ms) hard drive

Software
- Comes loaded with MS-DOS 6.0 and Microsoft Windows 3.1

Display
- Super-twisted 64 gray-scale, 10" LCD and 1024 x 768 for external monitor with 512k video RAM
- Optional dual-scan STN color display
- Adjustable contrast and brightness
- Visible LED indicator on cover-down

Keyboard
- Full-function keyboard with 85 keys and 4 inverted-T cursor control keys, 3.0mm keyboard spacing

Modem
- Fax-9600 baud send/4800 baud receive/2400 baud modem

I/O Ports
- PS/2 mouse interface/AT keyboard interface
- PCMCIA 2.0 slot
- Serial: 9-pin connector
- Parallel port
- Video: 15-pin connector for CRT
- 160-pin docking station
- Auxiliary battery port

Options
- 486 DX 33MHz CPU on selected models
- Docking station

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CIRCLE 085 ON READER SERVICE CARD

Benchmark Tests: Color Portables

The 33 portable systems in this roundup employ 11 different 486-level CPUs and various types of color displays. The top performers rely on well-integrated, speedy components as well as good power-management features and solid local-bus designs to get the job done.

What the Numbers Mean

PROCESSOR

The 11 processors represented fell into neat categories. The slowest were the Cyrix Cx486SLC/33 chips; units equipped with these chips averaged 9.8 on our processor tests. At the high end were the six 486DX2/66-based notebooks, which averaged 26.8 on our processor tests—about 25 percent below the score of an average desktop unit with the same CPU.

The three notebooks from Texas Instruments broke away from the orderly hierarchy. The TI TravelMate 4000E WinDX2/50 Active Color, with its score of 34.3, surpassed the fastest 486DX2/66-based notebook—the Poly 486-66NC—by 22 percent; TI's 486DX2/40-based system achieved an excellent score of 27.3, and its 486SX/25-based system led its processor group.

The three TI notebooks achieved their processor scores without the aid of external processor cache. They performed exceptionally with 16-bit and 32-bit memory read and write operations—especially when exercising extended memory. This fine performance results from the use of 16-nanosecond dynamic RAM chips and a customized core logic that takes full advantage of a 486 processor's burst mode. Instead of relying on static RAM as a cache to usher CPU instructions, this core logic allocates DRAM on the fly to act as its own cache where needed.

VIDEO

Only five video-chip manufacturers were represented. Even so, on our DOS video tests, chip make and model did not matter as much as the machine carrying the chip. The slowest unit on our DOS-based video tests, the TI TravelMate 4000 WinDX2/40 Color, had a Cirrus Logic CL-GD 6420 chip and posted a score of 966. But several other notebooks with the same chip scored much higher, including the two other TI units. The difference in these cases was in local-bus implementation. The TI 4000 WinDX2/40 has a proprietary local bus, but TI's 4000E models use an enhanced version of this local bus.

The FutureTech FutureMate 433nV's score of 2,912 was the fastest here. It carries a Cirrus Logic CL-GD 6225 chip in a VL-Bus implementation. Broadax Systems' BSI NP846T Active Color Notebook and the Wedge ShowBook IV AC—placing second and fourth, respectively—each had the same chip mated with a VL-Bus design. Placing third was the Austin 425-130, with a Western Digital WD90C24 chip in a proprietary local-bus design. Both of these chips turned up in slower notebooks, with and without local buses.

GRAPHICS WINMARK

Graphics WinMark scores showed a great deal of variance, with local-bus implementations providing a definitive advantage. For instance, none of the units with Graphics WinMark scores of 2 million pixels per second or less had local-bus video. Meanwhile, four of the five top-scoring notebooks on our Graphics WinMark tests sported local-bus designs, either VL-Bus or proprietary schemes.

The top-scoring two notebooks—the Wedge ShowBook, with a score of 4.6 million pixels per second, and Broadax's BSI NP846T, with a score of 4.1 million pixels per second—contained the same Cirrus Logic CL-GD 6225 chip with VL-Bus designs. The Poly 486-66NC, which tied for third place, had no local bus, but it was the only 486DX2/66-based system in this roundup with a Chips & Technologies CT65530 chip.

The NEC UltraLite Versa 33C came equipped with the same C & T video chip set. It tied for fifth place, with a Graphics WinMark score of 3.3 million pixels per second.

DISK, DOSMARK, AND DISK WINMARK

The most common hard disks were those from Conner Peripherals, Seagate Technology, and Toshiba America Information Systems. Most individual hard disks had speeds no faster than 19 milliseconds, and several of the Seagate models were as slow as 25 ms. The rule of thumb is: The more capable the processor, the higher the disk score.

Taking top disk honors, with a score of 892, was the BSI NP846T Active Color Notebook, a 486DX2/66-based unit with a 250MB, 15-ms Maxtor 25251AT. The only Maxtor disk here, it was the fastest-rated in the lineup. Taking second place, with a score of 767, was the HyperBook 3300DX2/50. It came equipped with one of the five Toshiba MK2224FC disks represented here, a 213MB model with a 19-ms access time. The only Quantum drive here—a 127MB Go drive rated at 17 ms—helped the Poly 486-66NC (another 486DX2/66-based unit) garner a third-place disk score of 758.

DOSmark results correlated even more closely with processor performance. While eight of the top ten notebooks on our DOS disk tests also made the top-ten DOSmark chart, all of the top ten notebooks on our processor tests found their way onto the top-ten DOSmark chart. Eight notebooks made the top ten in both DOS disk and Disk WinMark performance.

WINSTONE 94

Measuring all aspects of Windows performance is the application-intensive test suite Winstone 94, Version 1.0. Those notebooks that were strong performers throughout our entire testing procedure turned up in the Winstone

top ten. Seven of the top ten notebooks on our Graphics WinMark tests and seven of the top ten notebooks on our Disk WinMark tests found their way onto our top-ten Winstone list. While these two groups of seven were not identical, there were many common members. More than any other single indicator of performance, system memory affects a unit's Winstone score. A system memory level of 8MB or more was the common denominator among the top-scoring notebooks on our Winstone test.

Those notebooks with 8MB or more of RAM posted an average Winstone score of 26.5. By contrast, notebooks with 4MB of RAM posted an average Winstone score of 9.5.

Part of the reason for the marked difference is that the applications that make up the Winstone test suite require a minimum of 3MB of available RAM, and at least one—Borland's Paradox for Windows—recommends 6MB for effective operation. We observed time and again that the more system memory there was, the better the score. The only notebook with 8MB or more of RAM that didn't achieve a score above 20 was the HyperBook 3220SLC/33, but this unit was hampered by its Cyrix Cx486SLC/33 CPU.

BATTERY

Our testing showed that notebooks powered by nickel hydride batteries last longer than nickel cadmium cells. The 18 units with nickel hydride batteries lasted nearly 3.5 hours each during our continuous-use ZDigit battery test. Those with nickel cadmium batteries averaged just over 2 hours. All but one unit in the top ten had nickel hydride batteries.

The unit that demonstrated the best power management was the ZDS Z-Note 425Lnp+, which ran an impressive 5 hours. And this was with its processor set to full throttle. As with all notebooks, results improve when power management is set to maximum battery life, but just how much is hard to say. Take, for example, the nearly identical AST PowerExec 4/33SL ColorPlus and DECpc 425SLC. When set for maximum performance, these systems lasted for about 3 hours; on maximum battery time, they can reach 6 hours.

All systems here were equipped with color screens, so their battery scores were not as high as the scores garnered by the monochrome notebooks we've tested in the past. Notebooks with active-matrix designs, the greediest of color screens, also slightly underperformed their equivalent passive-matrix cousins. For example, the ZDS Z-Note 425Lnc+, Zenith Data Systems' active-matrix equivalent to the passive-matrix ZDS Z-Note 425Lnp+, ran 3 hours 39 minutes—1 hour 23 minutes less than the 425Lnp+. The same pattern emerged within the Logisys line: The Logisys Log-486DUA has a passive-matrix screen and posted a battery score of 2 hours 48 minutes. Its line mate, the active-matrix Logisys Log-486TFT, turned in a score of 2 hours 1 minute.

How We Tested

In preparing this issue, we used PC Bench 8.0 to predict processor, video subsystem, and disk performance using DOS applications. The DOSmark is a summary of those three results and estimates system performance under DOS.

We also used WinBench 4.0 to obtain Graphics and Disk WinMark scores, and we used Winstone 94, Version 1.0, to determine system performance under Microsoft Windows 3.1.

The **processor and memory** score gauges the speed of a PC's processor subsystem. This test measures CPU, RAM, and RAM cache performance. The score is based on a large instruction mix and either the floating-point coprocessor test or the floating-point emulation test, depending on whether a PC uses a coprocessor.

The **video** score is a weighted harmonic mean of tests that measure 8- and 16-bit VGA write operations involving both text and graphics.

The **disk** score gauges the performance of a PC's hard disk, disk controller, and any hardware or software disk caches. This test works with more than 100 files in six directories totaling over 30MB. The test includes file reads, file writes, file creation, and file deletion.

The **DOSmark** score is a composite rating derived from the processor, video, and disk test results. It indicates a PC's ability to run DOS applications quickly and efficiently.

The **Graphics WinMark** score is a measure of PC graphics performance under Microsoft Windows 3.1. We run 66 different tests to evaluate the systems' handling of the Windows GDI (Graphics Device Interface). The scores are reported in millions of pixels per second.

The **Disk WinMark** score reflects disk subsystem performance under Windows. The tests use different files and file operations in a blend based on extensive profiling of applications' disk usage.

Winstone 94 measures the time a PC takes to execute a set of application scripts thatoperate in 12 separate Windows 3.1 applications. Winstone scores have been normalized relative to a 386DX/25 Compaq with 4MB of RAM, which has a Winstone score of 10.

Battery testing using ZDigit, Version 2.0, is based on data accumulated over years of testing laptop and notebook battery lives and accurately reflects how long a notebook will operate between charges. To test these notebooks, we first condition their batteries with three consecutive-use cycles.

Then we set each unit's power-management feature for optimum performance. Hard disk timeout is set for 1 minute, displays are set for 2 minutes, and standby mode is set for 3 minutes (or the closest available setting, in each case). Units' suspend features are disabled. The ZDigit program is set with the following parameters: Active time equals 2 minutes, idle time equals 2 minutes, and sleep time equals 8 minutes.

Each notebook is then tested in one of three ways. If a notebook has a keyboard port and is able to accept certain keystroke commands, we administer our Undigit test.

The second procedure is our Boinker test, which involves a mechanical finger that physically hits keys at the same intervals that we use in our Undigit test. Some of the notebooks in this roundup have keyboard ports that cannot interpret Undigit's special keystrokes, and those have to be tested manually using the Mandigit protocol.

Two nearly identical notebooks—the AST PowerExec 4/33SL ColorPlus and the DECpc 425SLC—have highly intelligent power-management schemes that elude both the Undigit and Boinker tests; we tested these units using our Mandigit procedure.

The ZDigit protocol allows each notebook to go into its preset sleep mode after a period of inactivity. Then it brings up a Windows application and lets it run for a specified time by injecting the appropriate keystrokes. The state of the screen is constantly monitored, as is the parallel port. The cycle is repeated until the battery is depleted.

Going

Our new CT2 PhoX™ controller — the core technology in the newest CT2 digital cordless phone systems — is the latest expression of the DSP technology that makes us a leading supplier of telecommunications ICs in the world today.

APPLICATION SPECIFIC DSPs

Our 5.0 Volt-only Flash memories play a critical role in today's advanced digital cellular phones. While our low-voltage EPROMs play an equally important role in analog cellular designs. Both non-volatile memory families offer the right combination of packaging and speed that mobile communications applications demand.

NON-VOLATILE MEMORIES

AMD's 5.0 Volt-only Flash memory cards are instrumental in providing portable storage in state-of-the-art hand-held personal electronic devices — like personal digital assistants, schedulers, electronic notepads, personal communicators, pocket computers, and even electronic maps.

FLASH MEMORY PCMCIA CARDS

Where is everyone going these days? They're going mobile. And your next computing or communications device can go with them when you design-in AMD® technology.

Take advantage of AMD's vast expertise in process, packaging and design technologies — optimized for mobile computing and communications applications. So your next design can have more features, more speed, a smaller and lighter form factor, and longer bat-

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Mobile



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AMD will soon provide extensive wireless LAN/WAN capabilities — including wireless access to hardwired networks and even wireless peer-to-peer connectivity — the result of our strategic partnership with Xircom.

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Our low-voltage x86 CPUs, including our Am486™ and Am386® microprocessors, help provide sheer computing horsepower and the longest battery life available for notebooks, subnotebooks, palmtops, and pen-based systems. What's more, they're certified 100% Microsoft Windows™-compatible. Plus you get the support of over 40 FusionPC℠ Alliance Partners to help bring your designs to market faster.

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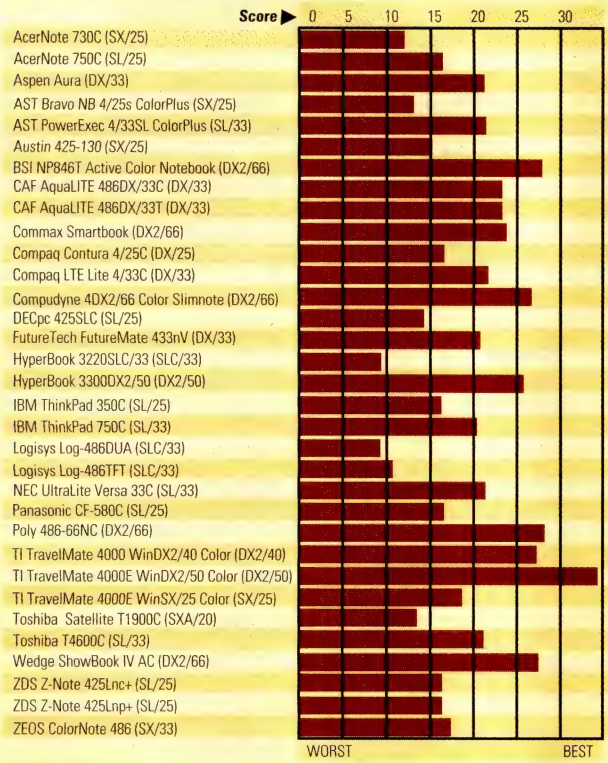
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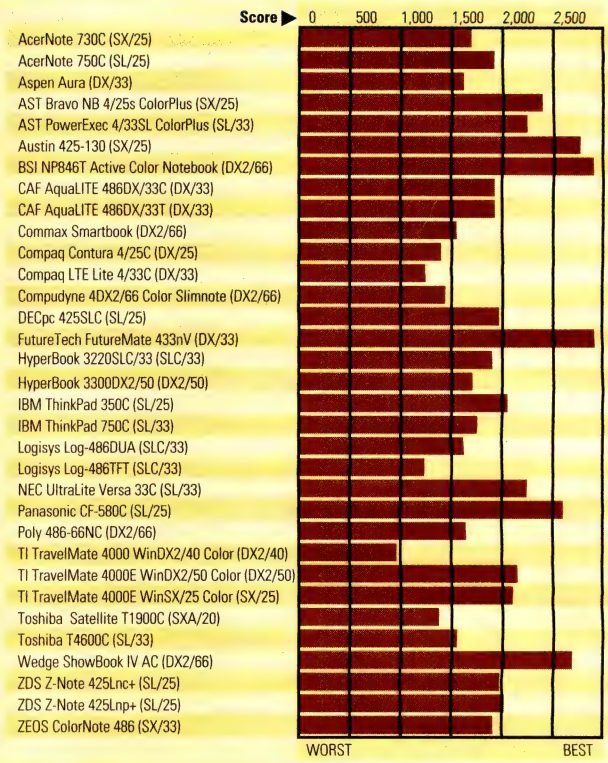
CIRCLE 017 ON READER SERVICE CARD

Benchmark Tests: Color Portables

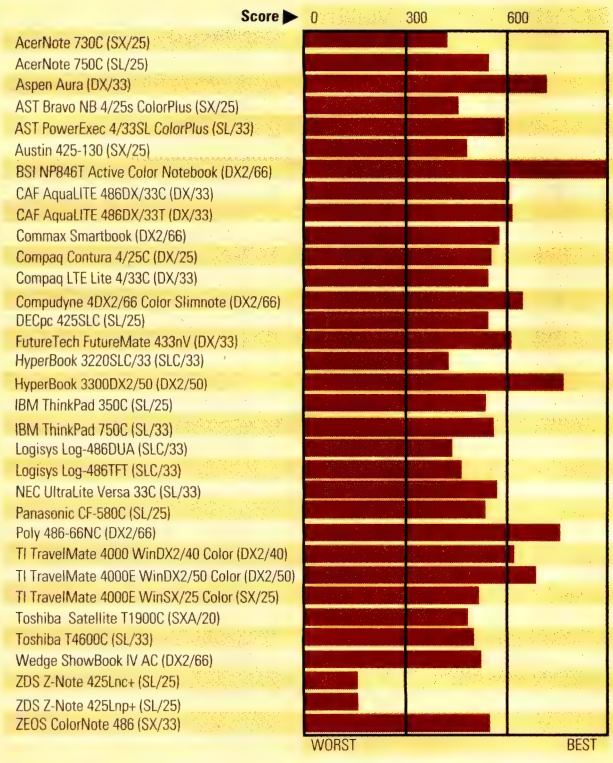
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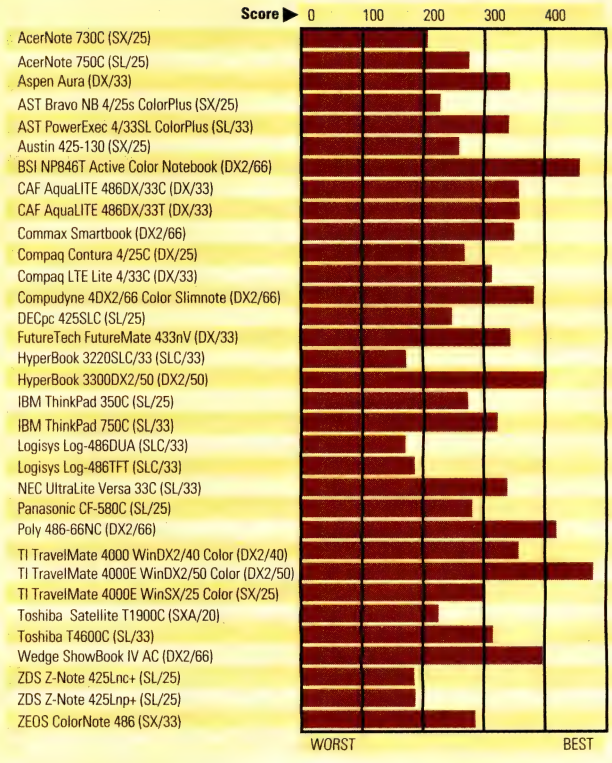
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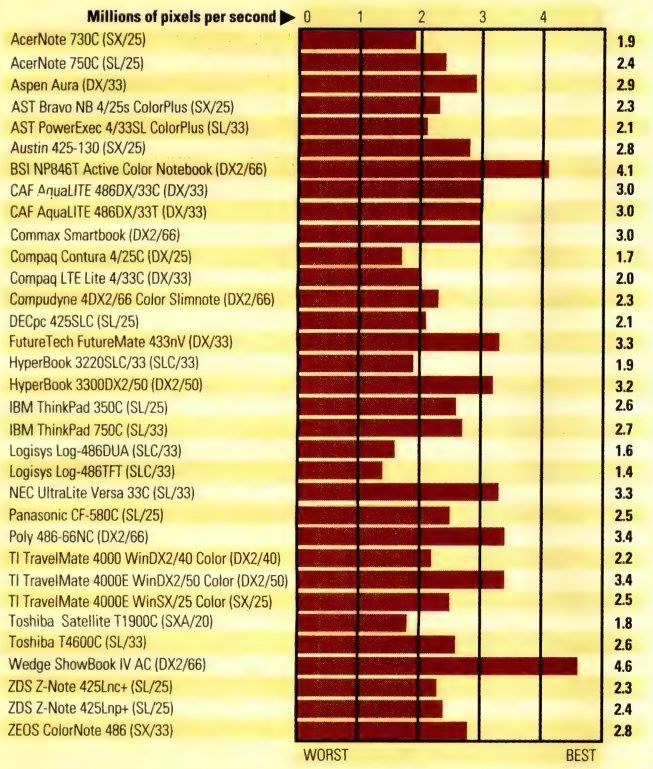
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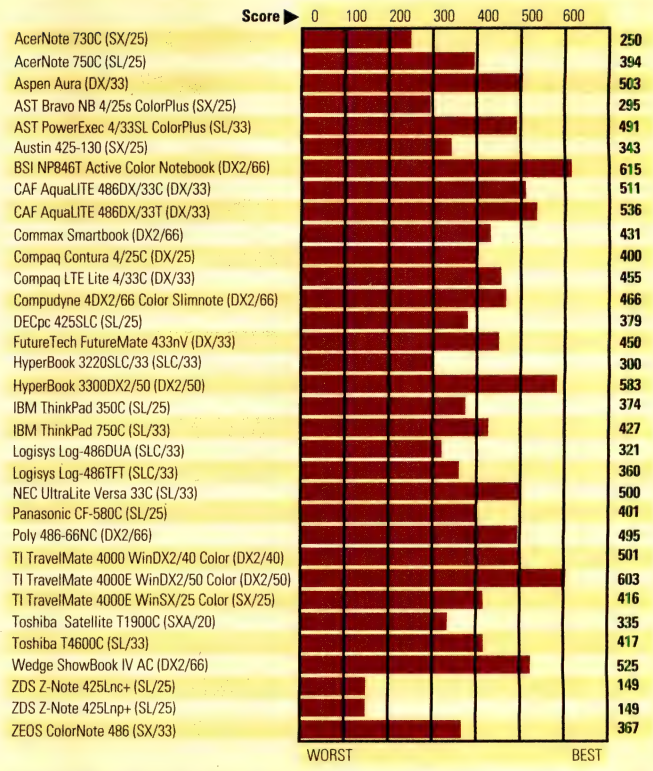
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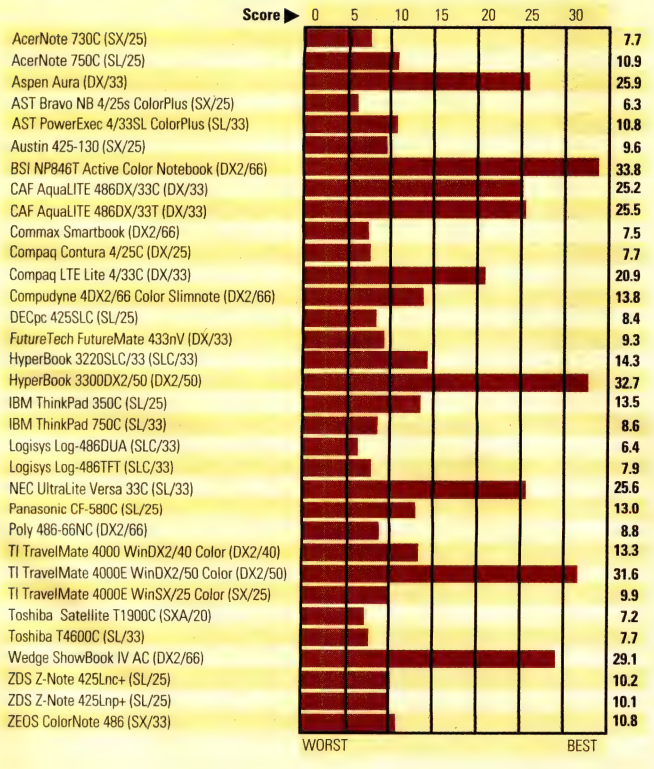
GRAPHICS WINMARK



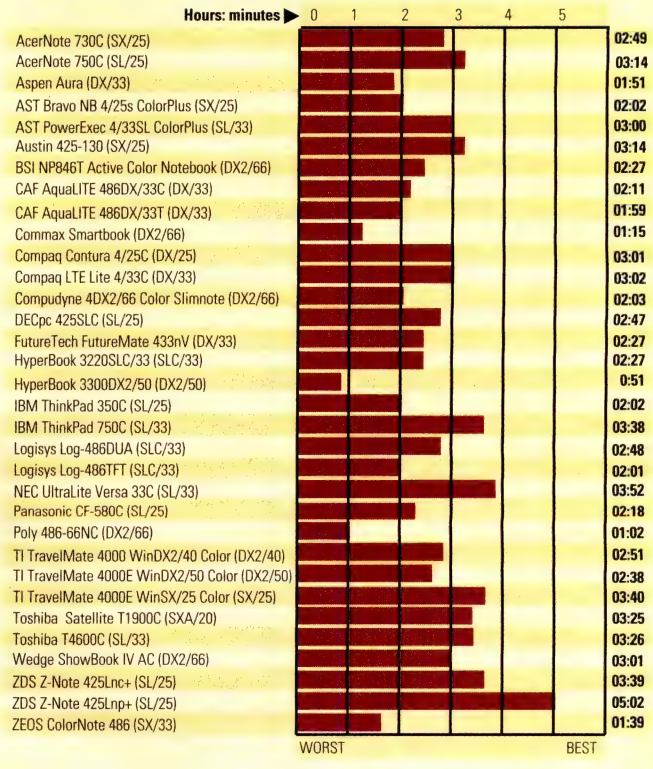
DISK WINMARK



WINSTONE



BATTERY



Acer America Corp.

AcerNote 730C
AcerNote 750C

The AcerNote 730C and AcerNote 750C share the same sturdy construction, logical design, and good battery life. Their performance, however, was midrange.

The $2,449 730C is based on an Intel 486SX/25 chip and uses an excellent dual-scan passive TFT Sharp screen. The $4,149 unit is based on an Intel 486SL/25 processor and has an active-matrix Toshiba display.

Each unit has a built-in trackball in front of the keyboard and a wrist rest that makes it comfortable to use. Though it is easy to upgrade RAM and the hard disk, there is no processor upgrade path; what you buy is what you get. Each case has two special buttons: One gives you immediate access to the BIOS setup, and the other can be configured to put the unit into standby or suspend mode.

AcerNote 730C

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Road warrior	GOOD
Desktop replacement	FAIR

Both units use nickel hydride batteries, but there is a lot of variation in battery size and life. The SX/25-powered 730C has a travel weight of 7.9 pounds and managed a battery life of 2 hours 49 minutes. It came to us with a 120MB hard disk and 4MB of RAM (which is expandable to 12MB) and turned in average scores on most of our tests. It posted a disappointing Winstone score of 7.7, however.

AcerNote 750C

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Road warrior	EXCELLENT
Desktop replacement	GOOD

By contrast, the 750C uses the power-conscious SL/25 processor and a battery that weighs 20 percent more than the 730C's battery. It managed a good 3 hour 14 minute battery time. The downside is the unit's 8.6-pound travel weight.

While the 730C posted midrange performance scores, the 750C bested them by about 25 percent on all measures. The 750C's active-matrix display produces a nice image, but the brightness control allows for only marginal adjustments. The 750C supports two Type-II PCMCIA devices or one Type-III device. It can handle up to 20MB of RAM and has a 128K flash BIOS system that allows field upgrades to the system BIOS. The 730C can go no higher than 12MB of RAM, has no provisions for PCMCIA, and can't support flash BIOS upgrades. It does have an internal modem slot, though.

Should problems arise, Acer promises a replacement system within 24 hours for the first year. Although both systems lack strong performance, the extra features and sharp display of the 750C make it a more reasonable choice than the 730C.—*Stephen W. Plain*



FACT FILE

AcerNote 730C

Estimated price: $2,449.

Tested configuration: 119MB Seagate ST9145A IDE hard disk with 64K buffer, 1.44MB floppy disk drive, 4MB RAM, built-in trackball, 2,400-/9,600-bps data/fax modem, DOS 6.0, Microsoft Windows 3.1, Microsoft Works for Windows, Phoenix MicroFax.

Options: 2MB RAM upgrade, $179; 4MB RAM upgrade, $289; 8MB RAM upgrade, $799; nickel cadmium battery, $99; nickel hydride battery, $169; numeric keypad, $69; extra AC adapter, $129; 12-volt battery adapter, $80.

AcerNote 750C

Estimated price: $4,149.

Tested configuration: 209MB Seagate ST9235A IDE hard disk with 64K buffer, 1.44MB floppy disk drive, 4MB RAM, built-in trackball, 2,400-/9,600-bps data/fax modem, DOS 6.0, Microsoft Windows 3.1, Microsoft Works for Windows, Phoenix MicroFax.

Options: Same as for 730C, except: 16MB RAM upgrade, $1,739; nickel cadmium battery, $119; nickel hydride battery, $199; PCMCIA data/fax modem, $299; PCMCIA twisted-pair LAN card, $399; PCMCIA coaxial LAN card, $399.

In short: Although solidly built and chock-full of features, both AcerNote systems lack strong performance.

Acer America Corp., 2641 Orchard Pkwy., San Jose, CA 95134; 800-733-2237, 408-432-6200; fax, 408-922-2954

441 ON READER SERVICE CARD

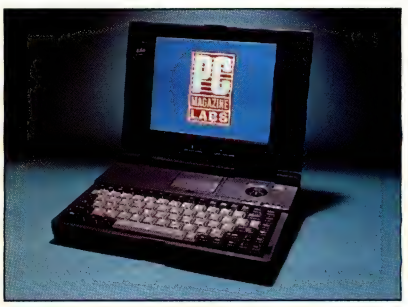
Aspen Computer Inc.

Aspen Aura

Polywell Computers Inc.

Poly 486-66NC

The Aspen Aura from Aspen Computer and the Poly 486-66NC from Polywell Computers are nearly identical units that come from the same manufacturer, Dual Enterprise Corp. Their configurations and prices differ, but each is offered at a reasonable cost; the 486DX/2-based Aura



FACT FILE

Aspen Aura

Aspen Computer Inc., 5813 Main St., #10, Buffalo, NY 14221; 800-472-3273, 716-626-0315; fax, 716-626-1541

List price: $2,695.

Tested configuration: 213MB Toshiba MK2224FC IDE hard disk with 128K buffer, 1.44MB floppy disk drive, 8MB RAM, built-in trackball, DOS 6.0.

Options: Toshiba 340MB hard disk upgrade, $200; 16MB RAM upgrade, $600; 20MB RAM upgrade, $1,100; 486DX2/66 processor upgrade, $300; docking station, $395; extra nickel hydride battery, $130; 2,400-/9,600-bps data/fax modem, $125; Ethernet LAN module, $125; SCSI module, $80; Sharp active-matrix color display upgrade, $800; PCMCIA slot module, $125; scanner interface module, $75; second serial port, $40.

In short: Midrange performance and poor battery life are balanced by good travel weight.

442 ON READER SERVICE CARD

SOUNDS LIKE THUNDER

RUNS LIKE LIGHTNING

PC WORLD BEST BUY

September 1993
466VL MAGNUM



PC MAGAZINE EDITORS' CHOICE

January 26, 1993
466 MAGNUM

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15 YEARS STRONG

ELECTRIFYING

15" MAG LX1564 SVGA color monitor
1280NI .28mm

Diamond Viper VLB graphics accelerator

7 expansion slots: 7 ISA, 2 VESA

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8MB RAM
245MB HD

SoundBlaster 16 CD-quality audio

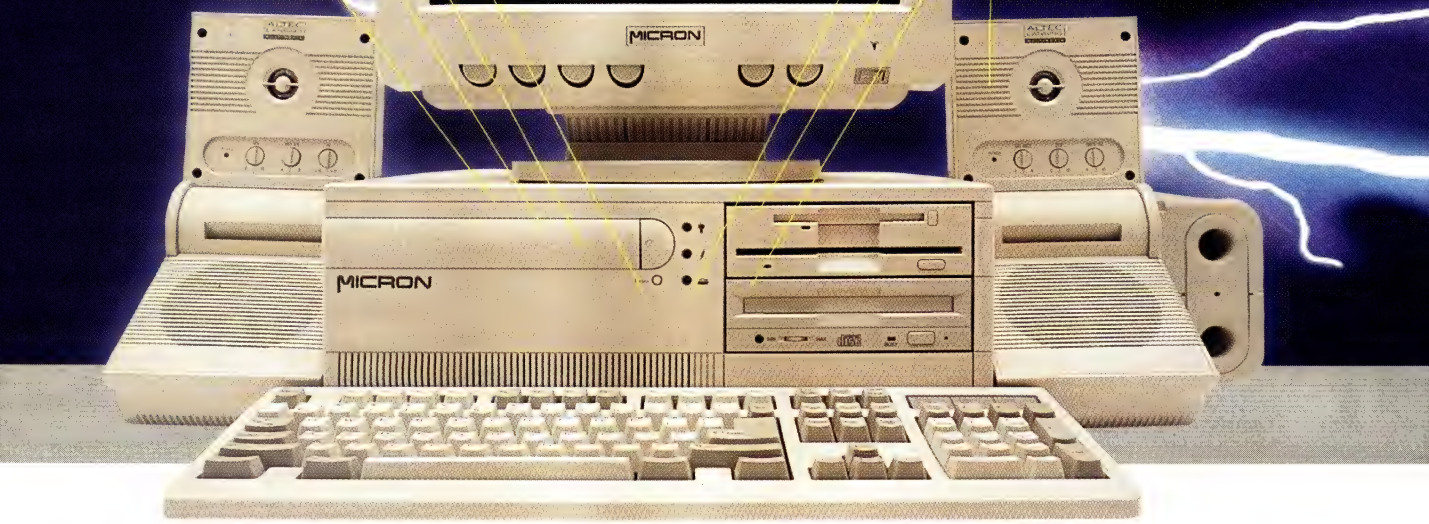
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280ms dual speed MPC CD-ROM drive

Optional Altec Lansing ACS 300 speaker system with subwoofer

intel inside

MICRON 466VL
$2699
MAGNUM MPC

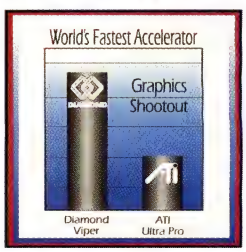


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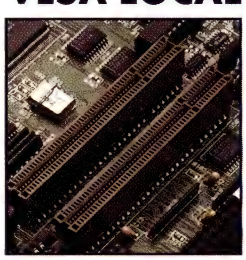
Powered by the Weitek P9000, the Viper VLB is up to 300% faster than the ATI Ultra Pro VLB. With 2MB of VRAM, you'll get 256 colors at 1280 x 1024 @ 74Hz and 16.7 million colors at 800 x 600. Turbo Windows and AutoCAD drivers included.

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MULTIMEDIA FROM MICRON

PC WORLD BEST BUY

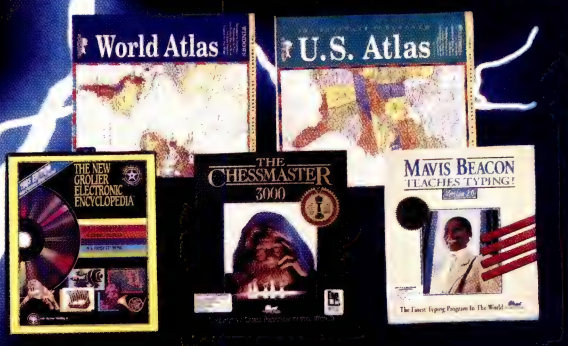
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PC MAGAZINE EDITORS' CHOICE

January 26, 1993
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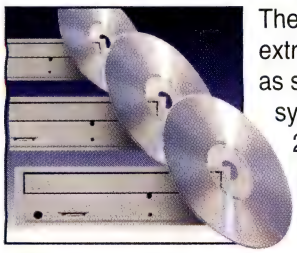


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- 7 Slots: 2 VESA, 7 ISA
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- Diamond SpeedStar Pro VLB (1MB)
- 14" MAG LX1450, 1024NI, .28mm
- Desktop "Tool Free" chassis
- Microsoft Mouse, 101-key keyboard
- MS-DOS 6 & Windows 3.1 on CD
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- Desktop "Tool Free" chassis
- Microsoft Mouse, 101-key keyboard
- MS-DOS 6 & Windows 3.1 on CD
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- Intel 486DX2 66MHz processor
- Pentium Technology Ready (ZIF)
- 16MB RAM, 340MB 14ms HD (VLB)
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- 15" MAG LX1564, 1280NI, .28mm
- Desktop "Tool Free" chassis
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- Choice of application software

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- Tower chassis with 7 drive bays
- Microsoft Mouse, 101-key keyboard
- MS-DOS 6 & Windows 3.1 on CD
- Choice of application software

$3,799 LEASE - $132/MO.

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- Intel 486DX2 66MHz processor
- Pentium Technology Ready (ZIF)
- 16MB RAM, 256K 15ns cache
- 527MB 10ms SCSI 2 HD (VLB)
- 8 slots: 2 VESA, 8 EISA
- 280ms CD-ROM drive, 3.5" floppy
- Diamond Viper VLB (2MB)
- 15" MAG LX1564, 1280NI, .28mm
- Tower chassis with 7 drive bays
- Microsoft Mouse, 101-key keyboard
- MS-DOS 6 & Windows 3.1 on CD
- Choice of application software

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- 8 slots: 2 VESA, 8 EISA
- 280ms CD-ROM drive, 3.5" floppy
- Diamond Viper VLB (2MB)
- 17" MAG MX17F, 1280NI, .26mm
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CIRCLE 119 ON READER SERVICE CARD

costs $2,695 and the 486DX2/66-based Poly costs $2,888. The two units also share disappointing battery lives.

These 7.8-pound portables come in 486SX/25, DX/33, and DX2/66 flavors. Each notebook's processor can be easily changed via a hinged door on top, and memory can be added by removing the keyboard. The hard disk is removable and slides easily out the left side. Rather than connecting peripherals via a PCMCIA slot, these systems use what are called personality module peripherals such as modems, PCMCIA slots, LAN adapters, SCSI ports, and trackballs. Unfortunately, there is only a single slot, so you can only use one at a time. This makes it impossible to use a trackball and modem at the same time.

Aspen Aura

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Road warrior	GOOD
Desktop replacement	EXCELLENT

The Aura came to us with 8MB of RAM and a 213MB hard disk, but it lacked the Poly's more powerful processor and modem module, as well as Windows 3.1. The Poly came with 4MB of RAM and a 120MB hard disk. Aspen offers a Sharp active-matrix display as an $800 option. Each unit's keyboard is comfortable, but the small ball used in the trackball module makes it a little difficult to maneuver accurately.

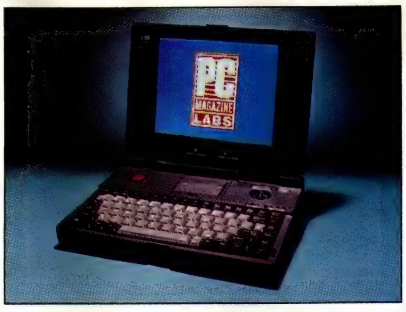
The Poly performed miserably on our battery test, lasting just 1 hour 2 minutes. The Aura did better at 1 hour 51 minutes. Carrying extra batteries isn't a clean solution, since each unit's keyboard must be removed to change the battery. Though nickel cadmium batteries are standard, nickel hydride batteries are supported as an option. These should provide better life.

Each unit's dual-scan passive screen produced a decent image, but their video subsystems, each based on the Chips & Technologies 65530 chip set, secured below-average scores on our DOS video tests. Both units performed very well on our DOS disk tests, but the results of our Winstone test showed the Aura to be more suitable for Windows work, largely because of its 8MB of RAM.

Poly 486-66NC

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Road warrior	FAIR
Desktop replacement	GOOD

The Aura comes with a one-year parts, two-year labor warranty, and the Poly comes with a standard one-year warranty.—*SWP*



FACT FILE

Poly 486-66NC

Polywell Computers Inc., 61-C Airport Blvd., San Francisco, CA 94080; 800-999-1278, 415-583-7222; fax, 415-583-1974

List price: $2,888.

Tested configuration: 126MB Quantum Bullet 120 IDE hard disk with 32K buffer, 1.44MB floppy disk drive, 4MB RAM, built-in trackball, 2,400-/9,600-bps data/fax modem, DOS 6.0, Microsoft Windows 3.1.

Options: 200MB hard disk upgrade, $200; 240MB hard disk upgrade, $250; 8MB RAM upgrade, $280; 16MB RAM upgrade, $560; 20MB RAM upgrade, $840; docking station, $600; nickel cadmium battery, $45; nickel hydride battery, $120; dual battery pack, $75; 9,600-/14,400-bps data/fax PCMCIA modem, $550; Ethernet card, $95; extra AC adapter, $45; SCSI card, $75.

In short: This notebook could last only an hour between charges, but it is one of the lightest packages here to incorporate a power processor.

457 ON READER SERVICE CARD

AST Research Inc.

AST Bravo NB 4/25s ColorPlus

The $3,549 AST Bravo NB 4/25s ColorPlus is an inexpensive active-matrix alternative to AST Research's PowerExec models. But when opting for the Bravo, the user gives up some upgrade flexibility, battery life, and performance.

The Bravo is based on the Intel 486SX/25 processor and comes standard with a 170MB hard disk, a Type-III PCMCIA slot, and 4MB of RAM, expandable to 20MB. The unit has the same basic design as the ZEOS ColorNote 486 (also reviewed) but differs in processor and screen type. Its design is sleek, yielding a light travel weight of only 6.6 pounds. The Bravo has built-in local-bus video that helped the unit post a respectable DOS video score and an average Graphics WinMark rating. On all of our other tests, the Bravo was unimpressive. It managed the lowest Winstone

AST Bravo NB 4/25s ColorPlus

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Road warrior	GOOD
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE



FACT FILE

AST Bravo NB 4/25s ColorPlus

AST Research Inc., 16215 Alton Pkwy., Irvine, CA 92718; 800-876-4278, 714-727-4141; fax, 714-727-9355

Estimated street price: $3,549.

Tested configuration: 136MB Western Digital AL2170 IDE hard disk, 1.44MB floppy disk, 4MB RAM, DOS 6.0, Microsoft Windows 3.1, Star Software B-Tools.

Options: 4MB RAM upgrade, $249; 16MB RAM upgrade, $2,199; PCMCIA 14.4-/9.6-Kbps data/fax modem, $599; PCMCIA 10BT Ethernet LAN adapter, $329; PCMCIA 10B2 Ethernet LAN adapter, $349; PCMCIA token-ring adapter, $789; numeric keypad, $99; external battery, $199; AC adapter, $99; auto adapter, $99.

In short: This local-bus portable showed barely average battery life and midrange performance.

443 ON READER SERVICE CARD

Price/Performance Index: *Color Portables*

With improved passive-matrix dual-scan screens, cheaper active-matrix screens, and longer battery lives, today's color notebooks are better than ever. Two-thirds of the 33 notebooks we reviewed are equipped with active-matrix screens, and almost half of those list for under $4,000. PCMCIA is becoming more common, present in nearly half of the notebooks reviewed. And 22 of the portables here offer either docking stations or port replicators, taking color notebooks one sure step closer to being true desktop replacements.

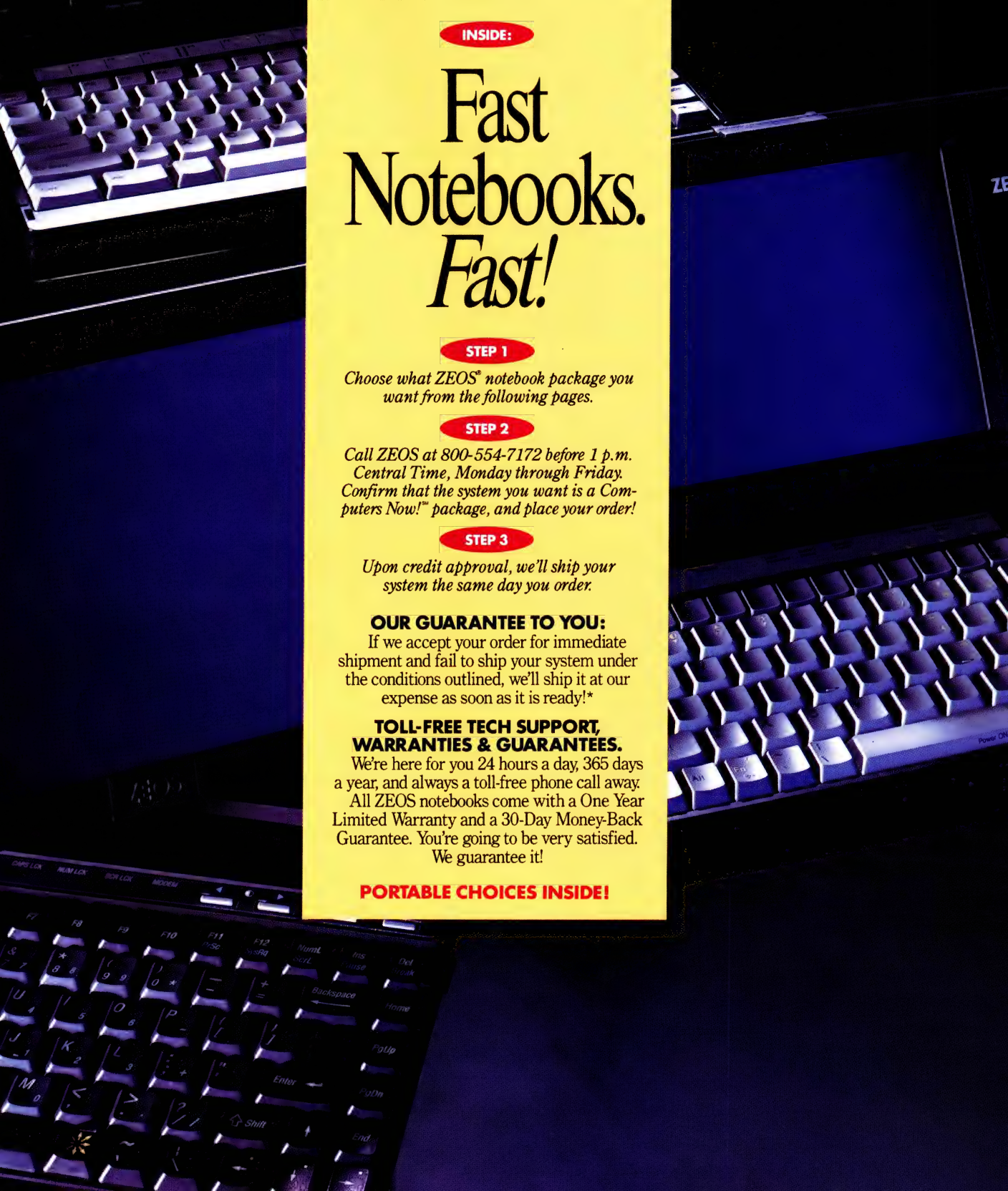
The right mix of price and performance remains elusive: The BSI NP486T offers a DX2/66 active-matrix color notebook with two PCMCIA Type II slots, a 250MB hard disk, a 14.4-Kbps fax modem, and above-avaerage performance for $4,200. The Wedge ShowBook has many of the same features but carries a 130MB hard disk and no modem for a slightly lower price, $4,064.

THE DATA POINTS

In determining performance scores, we considered benchmark test results (50 percent), size and weight (20 percent), RAM and hard disk capacities (10 percent), ZDigit battery life (10 percent), and other features (10 percent). The latter category gives credit for larger display size, external VGA support, built-in pointing devices, PCMCIA modem slots, internal modems, user-installable nonproprietary RAM and expansion units, high-speed serial and parallel ports, active-matrix (as opposed to passive-matrix) screens, port replicators, external keyboards, power-management features, and separate cursor keys.

The composite performance score is plotted on the x-axis; the selling price is plotted on the y-axis.





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- RAM expandable to 8MB for 486SL, 10MB for 386SL.
- IDE hard drive up to 120MB.
- Display: 640 x 480 VGA backlit, .23 dot pitch, Sharp 7.4" diagonal, up to 64 shades of gray.
- 256K (386SL version) or 512K (486SL version) video RAM.
- 486SL version includes 3.3V technology for added battery life, PI local bus for Windows acceleration, high-speed floppy drive controller, built-in math coprocessor.
- Supports simultaneous display with an external SVGA color monitor.
- Replaceable and rechargeable NiMH battery.
- 80-key keyboard with embedded numeric keypad and easy-to-use built-in trackball.
- Serial, parallel and video ports, plus ports for optional internal fax modem and external floppy drive.
- Fully-featured power management.
- 9.7" x 6.1"; 3.9 lbs.
- FCC Certified Class B.
- Complete ZEOS Customer Satisfaction Package.

PACKAGE 1

386SL Contenda: $995
Lease $42/month

486SL Contenda: $1495
Lease $63/month

- 2MB RAM (386SL); 4MB RAM (486SL)
- 80MB IDE hard drive

PACKAGE 2

386SL Contenda: $1295
Lease $55/month

486SL Contenda: $1795
Lease $65/month

- 4MB RAM
- 80MB IDE hard drive
- External 3.5" floppy disk drive
- Microsoft DOS 6.2 and Windows for Workgroups 3.11. Plus Lotus Organizer.

PACKAGE 3

386SL Contenda: $1595
Lease $67/month

486SL Contenda: $2195
Lease $79/month

- 4MB RAM (386SL); 8MB RAM (486SL)
- 80MB IDE hard drive
- External 3.5" floppy disk drive
- Custom leather carrying case
- Extra battery
- Internal 96/48/24 send/receive fax modem
- Microsoft DOS 6.2 and Windows for Workgroups 3.11. Plus Lotus Organizer.



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What's more, with a standard 80MB hard drive, memory up to 10MB and your choice of a 386SL-25 or 486SL-25 Intel processor, the Contenda has plenty of power to run Windows. You'll also find you can work longer because the processor is intelligent enough to power-down the memory, disks, modem and more when they're not in use. In addition, the compact package includes a built-in trackball and high-resolution backlit screen.

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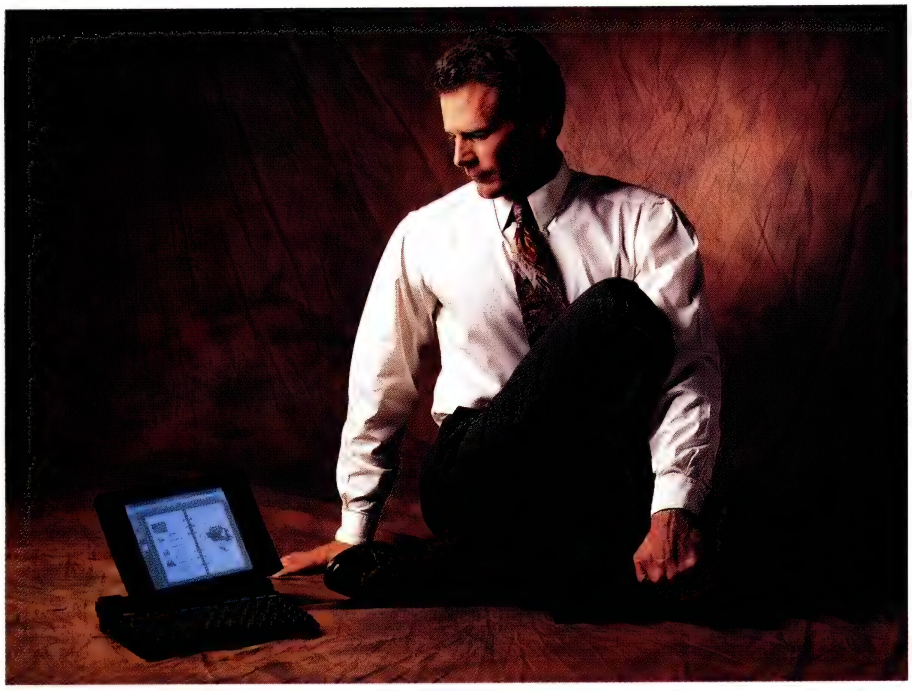
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- Microsoft DOS 6.2

PACKAGE 2

386SL Freestyle: $1795
Lease $65/month

486SL Freestyle: $1995
Lease $72/month
- 6MB RAM (386SL); 4MB RAM (486SL)
- 120MB IDE hard drive (386SL); 180MB IDE hard drive (486SL)
- Custom nylon carrying case
- Microsoft DOS 6.2
- Microsoft Windows for Workgroups 3.11

PACKAGE 3

386SL Freestyle: $2295
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Lease $90/month
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- Microsoft Windows for Workgroups 3.11

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The ZEOS® ColorNote™... scaling new heights.



With color and power you can't beat, the ZEOS ColorNote 486 is the only color notebook worth taking note!

We started with a reliable 486SX Intel processor running at 33MHz. Then we loaded it with enough memory and power to run Windows: 4MB or 8MB RAM (expandable to 20MB), an 80MB, 120MB or 170MB IDE hard drive and an 8K built-in cache. And, we added local bus video for super-fast video performance.



ZEOS dual scan screen (left) fires up rich, vibrant colors while standard passive matrix screen (right) produces faded and dull colors. Photos are not retouched.

Blazing colors seem to sing. Images are vibrant and alive. For a crisp VGA backlit screen displaying up to 256 colors, the ColorNote employs dual scan technology–a breakthrough that achieves color comparable to that of a desktop color monitor yet not as expensive as active matrix.

What's more, it comes equipped with a PCMCIA slot, an internal floppy drive, built-in trackball and a Nickel-Metal Hydride battery. If your needs go beyond the standard scale, you can compose a personalized package with our many options. Let the ColorNote be the basis for your creative scores and presentations.

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- Lotus Organizer

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Circle 151 on reader service card.

score here and had a subpar battery life of 2 hours 2 minutes.

The Bravo's Spacebar is shorter than normal to allow for the built-in trackball. In a unique design twist, the buttons are located below the trackball, making it a little difficult to operate. Another problem is that the hinges for the display do not provide enough resistance to hold the screen at an angle. Another unusual feature is that you control the display's brightness and contrast via arrow-key/function-key combinations.

Users can upgrade only the Bravo's memory. Here, the Bravo differs from units in AST's PowerExec series, which offer processor and disk upgrades. Two memory upgrade kits are available in 4MB and 16MB sizes.

With poor battery life, poor performance, and lack of upgradability, the Bravo—which comes with a standard one-year warranty—falls short.—*SWP*

AST Research Inc.

AST PowerExec 4/33SL ColorPlus

The $4,400 active-matrix PowerExec 4/33SL ColorPlus provides excellent battery life and a broad range of features and options that make it one of the most well-rounded laptops you can buy.

The PowerExec is based on the power-efficient 3.3-volt Intel 486SL/33 chip and comes in various configurations with different screens, hard disk capacities, and memory sizes. The tested unit was a model 203W that used a 9.5-inch active-matrix color display, a 204MB hard disk, and 4MB of RAM. Also included with this model were AST Research's front-mounted, clip-on trackball and Microsoft Windows 3.1.

AST PowerExec 4/33SL ColorPlus

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Road warrior	EXCELLENT
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE



FACT FILE

AST PowerExec 4/33SL ColorPlus

AST Research Inc., 16215 Alton Pkwy., Irvine, CA 92718; 800-876-4278, 714-727-4141; fax, 714-727-9355

Estimated price: $4,400.

Tested configuration: 204MB Seagate ST9235AG IDE hard disk with 64K cache, 1.44MB floppy disk, 4MB RAM, snap-on trackball, DOS 6.0, Microsoft Windows 3.1.

Options: 340MB hard disk upgrade, $804; 4MB RAM upgrade, $200; 8MB RAM upgrade, $885; 16MB RAM upgrade, $1,770; docking station, $488; port replicator, $139; extra nickel hydride battery, $160; PCMCIA 14.4-/9.6-Kbps data/fax modem, $550; AC adapter, $80; car adapter, $145; drive bay adapter, $99.

In short: Although pricey, the AST PowerExec 4/33SL ColorPlus offers good battery life and is well designed. Its trackball can be awkward to use, however.

443 ON READER SERVICE CARD

The display offers a crisp, bright image, and the keyboard is comfortable. And the system's 3-hour battery life is achieved through one of the most sophisticated processes we've seen. The notebook actually monitors usage patterns and adjusts the various component timeouts to squeeze the last bit of juice from its nickel hydride battery. When you finally do run low on power, a "hot-swapping" feature lets you change batteries without turning the computer off. The PowerExec has a travel weight of 8 pounds. The hard disk is easily removable, and a $99 drive bay adapter from AST plugs into a 5.25-inch bay of your desktop machine.

The PowerExec did well on all of our benchmark tests, consistently placing in the top third of all machines tested.

The PowerExec comes with AST's ExeCare Plus standard warranty, which includes 48-hour return and paid two-way shipping of a broken unit.

In sum, the PowerExec is a flexible unit that straddles the line between desktop and portable. The system's battery life, coupled with its quality and flexibility, makes this unit an excellent choice for a high-end portable.—*SWP*

Austin Computer Systems Inc.

Austin 425-130

Priced at $2,999, the 486SX/25-based Austin 425-130 is among the new class of portables that gives you the benefit of fast local-bus video. This offering from Austin Computer Systems has a 32-bit proprietary local-bus scheme that meshes well with the system's Western Digital video controller and NEC active-matrix color display. These fine components add up to a hard-to-beat combination.

With a travel weight of 7.9 pounds, the



FACT FILE

Austin 425-130

Austin Computer Systems Inc., 10300 Metric Blvd., Austin, TX 78758; 800-752-1577, 512-339-3500; fax, 512-454-1357

List price: $2,999.

Tested configuration: 130MB Toshiba MK-2124FC IDE hard disk with 128K cache, 1.44MB floppy disk, 4MB RAM, built-in trackball, DOS 6.0, Microsoft Windows 3.1.

Options: 4MB RAM upgrade, $299; 16MB RAM upgrade, $1,599; docking station, $399; 2,400-/9,600-bps data/fax modem, $199; 9,600-/14,400-bps data/fax modem, $299; 14,400-bps PCMCIA data/fax modem, $399; nickel cadmium battery, $99; nickel hydride battery, $199; battery charger, $49; AC adapter, $79; 12-volt battery adapter, $99.

In short: Local bus helps bring this system to the top of video performance, but the Austin 425-130 needs a more capable processor.

444 ON READER SERVICE CARD

Battery Life vs. Portability

The IBM ThinkPad 750C, TI TravelMate 4000E WinSX/25 Color, and ZDS Z-Note 425Lnc+ each effectively combine a travel weight of below 8 pounds with a 3.5-hour battery life. These are our prime choices as road warriors of distinction.

Keeping in mind that the ability to reproduce color images takes a toll on your battery and can easily add at least a half-pound to the weight of a typical monochrome system, it's notable to see nine systems in this roundup that combine travel weights of about 8 pounds with battery lives above 3 hours.

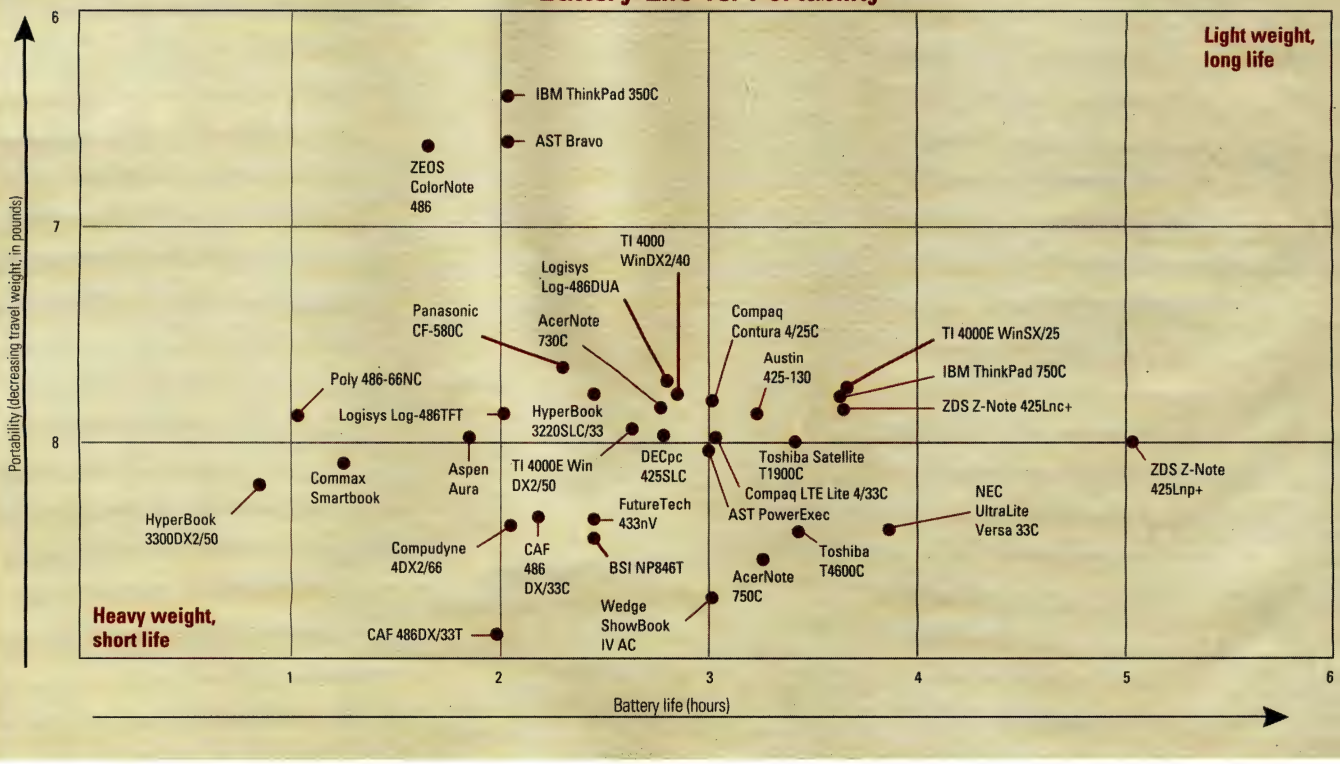
Four of these nine notebooks use active-matrix screens—the Austin 425-130; the Compaq LTE Lite 4/33C; the IBM ThinkPad 750C, our Editors' Choice; and Zenith Data Systems' Z-Note 425Lnc+.

Of these, the 750C and the 425Lnc+ stand out with nearly identi-

Battery Life vs. Portability

	Travel weight (pounds)	Battery life (hours:minutes)	Battery weight (pounds)	Battery life per pound (hours:minutes)
AcerNote 730C	7.9	2:49	1.2	2:20
AcerNote 750C	8.6	3:14	1.4	2:18
Aspen Aura	8.0	1:51	1.1	1:40
AST Bravo NB 4/25s ColorPlus	6.6	2:02	1.0	2:02
AST PowerExec 4/33SL ColorPlus	8.0	3:00	1.5	2:00
Austin 425-130	7.9	3:14	1.3	2:29
BSI NP846T Active Color Notebook	8.5	2:27	1.4	1:45
CAF AquaLITE 486DX/33C	8.4	2:11	1.6	1:21
CAF AquaLITE 486DX/33T	8.9	1:59	1.6	1:14
Commax Smartbook	8.1	1:15	1.0	1:15
Compaq Contura 4/25C	7.8	3:01	1.3	2:19
Compaq LTE Lite 4/33C	8.0	3:02	1.3	2:20
Compudyne 4DX2/66 Color Slimnote	8.4	2:03	1.5	1:22
DECpc 425SLC	8.0	2:47	1.5	1:51
FutureTech FutureMate 433nV	8.4	2:27	1.4	1:45
HyperBook 3220SLC/33	7.8	2:27	1.2	2:02
HyperBook 3300DX2/50	8.2	0:51	1.2	0:42
IBM ThinkPad 350C	6.4	2:02	1.0	2:02
IBM ThinkPad 750C	7.8	3:38	1.2	3:01
Logisys Log-486DUA	7.7	2:48	1.1	2:32
Logisys Log-486TFT	7.9	2:01	1.1	1:50
NEC UltraLite Versa 33C	8.4	3:52	1.1	3:30
Panasonic CF-580C	7.7	2:18	0.9	2:33
Poly 486-66NC	7.9	1:02	1.0	1:02
TI TravelMate 4000 WinDX2/40 Color	7.8	2:51	1.3	2:11
TI TravelMate 4000E WinDX2/50 Active Color	8.0	2:38	1.3	2:01
TI TravelMate 4000E WinSX/25 Color	7.8	3:40	1.3	2:49
Toshiba Satellite T1900C	8.0	3:25	1.2	2:50
Toshiba T4600C	8.4	3:26	1.5	2:17
Wedge ShowBook IV AC	8.7	3:01	1.7	1:46
ZDS Z-Note 425Lnc+	7.9	3:39	1.2	3:02
ZDS Z-Note 425Lnp+	8.0	5:02	1.3	3:52
ZEOS ColorNote 486	6.6	1:39	1.0	1:39

Battery Life vs. Portability



cal measures that sit at the center of our Battery Life vs. Portability chart. The 750C weighs in at 7.79 pounds and can run for 3 hours 38 minutes, and the 425Lnc+ weighs 7.85 pounds and has a battery life of 3 hours 39 minutes.

The two Compaq units—the Compaq Contura 4/25C and the Compaq Lite—have nearly identical battery times, but they differ in terms of weight. The Compaq LTE Lite, which many use as a desktop replacement, is about a half-pound heavier.

Predictably, the machine with the longest battery life—the ZDS Z-Note 425lnp+—is a passive-matrix unit. But strong performance requires tradeoffs. At 5 hours 2 minutes, the 425Lnp+'s battery life beats the WinSX/25's battery life by 1 hour 22 minutes, but the 425Lnp+ also weighs a quarter of a pound more.

Since no other notebooks in our roundup have battery lives above 5 or even 4 hours, the nearest competition for the Lnp+ in terms of battery life comes from the active-matrix NEC UltraLite Versa 33C, which scored 3 hours 52 minutes on our battery test. This showing is the highest among the tested active-matrix units and tops the lives of most of the tested passive-matrix systems as well.

If light weight is your most important concern, then you may want to consider the AST Bravo NB 4/25s ColorPlus, the IBM ThinkPad 350C, or the ZEOS ColorNote 486. These three PCs weigh in at under 7 pounds. They do so, however, by scrimping on battery time; even the most efficient can do no better than about 2 hours of operation between charges.

The small wonder of this test was the passive-matrix 350C, which at 6.4 pounds makes one wonder what the 9-pound systems have that the 350C doesn't. One answer is battery life; it can last only 2 hours 2 minutes.

active-matrix Austin's battery provides more than 3 hours of unassisted power, according to our Battery Rundown test. The notebook's SX/25 processor, however, is a poor match for the system's raw video processing speed, and paying $400 more for the same system with a 486DX/33 chip makes a lot of sense. At the high end, the unit is available with a 486DX2/66 CPU.

The Austin showed fine results on our benchmark tests, posting especially remarkable results on our DOS video and Graphics WinMark tests. Here, it outperformed systems with processors many levels above its SX/25 chip; it ranked third overall in DOS video performance and 12th overall in Graphics WinMark performance. Its other test results were in line with its processor class. The use of an SX/25 CPU helped secure the Austin's battery time of 3 hours 14 minutes.

Austin 425-130

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Road warrior	EXCELLENT
Desktop replacement	GOOD

An interesting bonus is the Type-III PCMCIA slot, which is tall enough to handle combinations of Type-I and Type-II cards. Other features include an innovative, front-mounted, docking-station expansion connector for the portable's $399 docking option; a simultaneous LCD and external monitor display; a front-mounted, centered trackball; and a selection of three modems, including the PCMCIA-based 14,400-bps send/receive fax modem.

The Austin is available with a standard one-year warranty.—*Greg Pastrick*

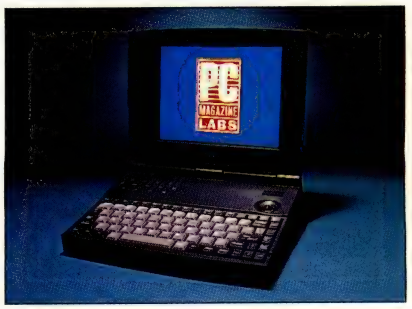
Broadax Systems Inc.

BSI NP846T Active Color Notebook

FutureTech Systems Inc.

FutureTech FutureMate 433nV

Built of the same core components and packaged in identical cases, the BSI NP846T Active Color Notebook and FutureTech FutureMate 433nV are brothers born to different fathers. And while their memory, drive capacities, and processors may differ, the VESA local-bus technology in each give these two variations on the same active-matrix color-notebook theme a clear performance advantage over their similarly configured and priced peers.



FACT FILE

BSI NP846T Active Color Notebook

Broadax Systems Inc., 9440 Telstar Ave., #4, El Monte, CA 91731; 800-872-4547, 818-442-0020; fax, 818-442-4527

List price: $4,200.

Tested configuration: 251MB Maxtor 25252AT IDE hard disk with 32K cache, 1.44MB floppy disk; 8MB RAM, mouse, 14,400-bps data/fax modem, DOS 6.0.

Options: 16MB RAM card, $1,260; docking station, $495; extra nickel cadmium battery, $85; 14,400-bps data/fax PCMCIA modem, $495; PCMCIA Xircom Ethernet BNC or 10BaseT adapter, $295; PCMCIA Xircom Ethernet adapter with BNC and 10BaseT, $345; external numeric keypad, $40; 12-volt extra AC adapter, $95; battery adapter, $40.

In short: Reasonable battery life, excellent performance, and local-bus video add up to a winner for Broadax.

445 ON READER SERVICE CARD

The $4,200, 486DX2/66-based Broadax comes with 8MB of RAM, a 251MB hard disk, and a 14,400-bps Megahertz PCMCIA fax/modem card. The $3,729, 486DX/33-based FutureMate includes 4MB of RAM, a 120MB hard disk, and the same PCMCIA fax/modem card. Each unit is based on an ETEQ chip set and flash upgradable Award

BSI NP846T Active Color Notebook

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Road warrior	GOOD
Desktop replacement	EXCELLENT

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Texas Instruments

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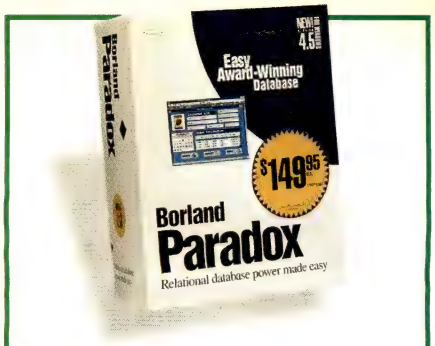
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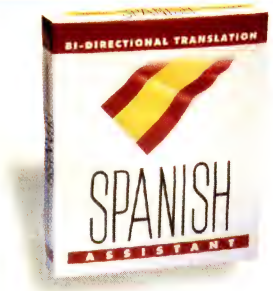
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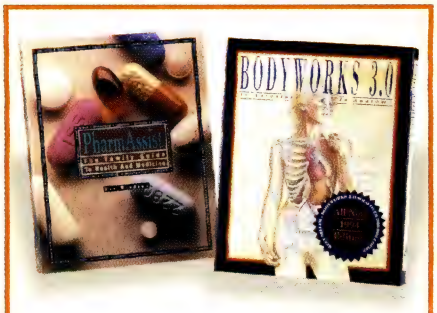
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FACT FILE

FutureTech FutureMate 433nV

FutureTech Systems Inc., Six Bridge St., Hackensack, NJ 07601; 800-275-4414, 201-488-4414; fax, 201-488-4405

List price: $3,729.

Tested configuration: 121MB Conner CP2124 IDE hard disk with 32K buffer, 1.44MB floppy disk, 4MB RAM, mouse, 14,400-bps PCMCIA data/fax modem, DOS 6.0, Microsoft Windows 3.1.

Options: Docking station, $525; extra nickel cadmium battery, $90; 14,400-bps data/fax PCMCIA modem, $495; PCMCIA Ethernet adapter, $265; external numeric keypad, $60; 12-volt battery adapter, $45.

In short: Priced lower than its Broadax twin, the FutureTech FutureMate 433nV represents a more budget-conscious approach to power computing on the road.

451 ON READER SERVICE CARD

BIOS, and each owes its fine performance on our benchmark tests to its built-in local-bus IDE controller and Cirrus Logic color display technology.

Indeed, these portables showed remarkable performance. The FutureMate posted the fastest raw DOS video score of all the notebooks here, while the Broadax earned the top ranking on our DOS disk, Disk WinMark, and Winstone tests. Across the board, the 8.5-pound Broadax and 8.4-pound FutureMate performed at the top of their respective processor classes. The one exception was the FutureMate's Winstone score, which ranked 22nd out of the 33 tested units. The FutureMate is thus more appropriate for use under DOS rather than Windows.

FutureTech FutureMate 433nV

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	FAIR
Road warrior	GOOD
Desktop replacement	GOOD

On the power front, the portables are designed with built-in power-management features, which allow for user-programmable sleep modes of varying lengths. Each notebook unfortunately uses a nickel cadmium battery rather than a nickel hydride battery, but each can take a charge quickly. Both units posted identical 2-hour 27-minute battery times, which is roughly average for this test of color notebooks.

It's clear these systems benefit from the VESA local-bus technology, but the upgrade options add value too. Each unit supports a range of 486 processors and memory, disk, and display upgrade options. The bundled Megahertz fax/modem card uses the appealing X-jack, rather than an ungainly dongle, that pops out of the card's side to connect to telephone lines.

Both units feature simultaneous external displays and come with one-year warranties.—*GP*

CAF Technology Inc.

CAF AquaLITE 486DX/33C
CAF AquaLITE 486DX/33T

CAF Technology's pair of 486DX/33-based active- and passive-matrix color notebooks are the only systems in this roundup that have left-mounted trackballs. Designed for the lefties among us, the CAF AquaLITE 486DX/33C and CAF AquaLITE 486DX/33T are good all-around notebooks that offer high performance and don't skimp on the extras.

Priced at $2,899, the passive-matrix 486DX/33C comes with 8MB RAM, a 130MB Toshiba hard disk, and a 2,400-/9,600-bps fax/modem card. The active-matrix 486DX/33T comes in the same configuration at a list price of $4,199. The AquaLITEs are nearly identical in design and performance. One difference is that the 486DX/33C has screen controls and a suspend/resume button on the lower right of the display, while the 486DX/33T has just a screen adjustment wheel.

The 486DX/33T's 8.9-pound travel weight is slightly heavier than the 486DX/33C's 8.4-pound weight. With the exception of the docking station and external monitor connectors, all ports and connections—including the 3.5-inch floppy drive bay—are laid out on the sides of the AquaLITEs. This is a particularly good design feature. The only odd design point with each of these units is the



FACT FILE

CAF AquaLITE 486DX/33C

List price: $2,899.

Tested configuration: 130MB Toshiba MK-2124FC IDE hard disk with 32K buffer, 1.44MB floppy disk, 8MB 70-ns RAM, built-in trackball, 2,600-/9,600-bps fax modem, DOS 6.0, Microsoft Windows 3.1.

Options: 213MB hard disk upgrade, $235; external 5.25-inch floppy disk, $266; 4MB RAM upgrade, $285; docking station, $323; extra nickel cadmium battery, $98; 2,400-/9,600-bps fax modem, $285; numeric keypad, $79; external battery charger, $143; AC adapter, $90.

CAF AquaLITE 486DX/33T

List price: $4,199.

Tested configuration: 130MB Toshiba MK-2124FC IDE hard disk with 32K buffer, 1.44MB floppy disk, 8MB 70-ns RAM, built-in trackball, 2,400-/9,600-bps fax/modem, DOS 6.0, Microsoft Windows 3.1.

Options: Same as for the 486DX/33C.

In short: Designed to appeal to lefties, the CAF AquaLITE series provides good performance but cuts users off with subpar battery times.

CAF Technology Inc., 1315 Johnson Dr., City of Industry, CA 91745; 800-336-9369, 818-369-3690; fax, 800-329-2537

446 ON READER SERVICE CARD

CAF AquaLITE 486DX/33C

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Road warrior	GOOD
Desktop replacement	GOOD

unusual switch above the keyboard for swapping serial functions from the trackball to the COM1 port. Also, both units lack PCMCIA slots.

Performance was consistent and even-handed. The notebooks posted scores that landed in the top ten on nearly all of our benchmark tests. They led the DX/33 group and fared better than many systems with more-capable CPUs. The highlights of their benchmark test showing were disk and graphics performance under Windows and their above-average Winstone performance. The 486DX/33C earned a Winstone score of 25.2, while the 486DX/33T posted a Winstone score of 25.5.

CAF AquaLITE 486DX/33T

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Road warrior	GOOD
Desktop replacement	GOOD

The passive-matrix 486DX/33C managed a 2-hour 11-minute battery score, while the active-matrix 486DX/33T ran down its battery in 1 hour 59 minutes. Both scores were below average.

CAF includes several extras with the AquaLITEs, including phone cables, external keyboard/keypad connector cables, and carrying cases. Interesting options for this pair of high performers include a $266 external drive, a $323 docking station, and a $79 keypad. Both units come with one-year warranties.—*GP*

Commax Technologies Inc.

Commax Smartbook

The Commax Smartbook is designed to be a flexible platform that fits the computing and pricing needs of a variety of users. Configuration options include a 486DX/33 or 486DX2/66 processor and a 120MB or 200MB hard disk. You can also buy the unit with a 2,400/9,600-bps fax/modem card and up to 20MB of

Commax Smartbook

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	FAIR
Road warrior	FAIR
Desktop replacement	GOOD

Late Arrivals

Arriving too late to undergo the full round of performance testing, these four notebooks and two notable notebook accessories caught our attention. All should be available by the time this issue goes to press.



The combination of an Inex Technologies Model 4000 Series notebook and a SyDOS Personal CD makes on-the-go Windows sound applications a reality. The Inex comes with a tiny built-in microphone, an AudioDrive Windows-compatible sound chip, and PCAudio software. You can buy the model with CPUs ranging from a 486SX/25 to a 486DX2/66. The SyDOS Personal CD connects to the parallel port of any PC and provides a maximum transfer rate of 176.4 Kbps.



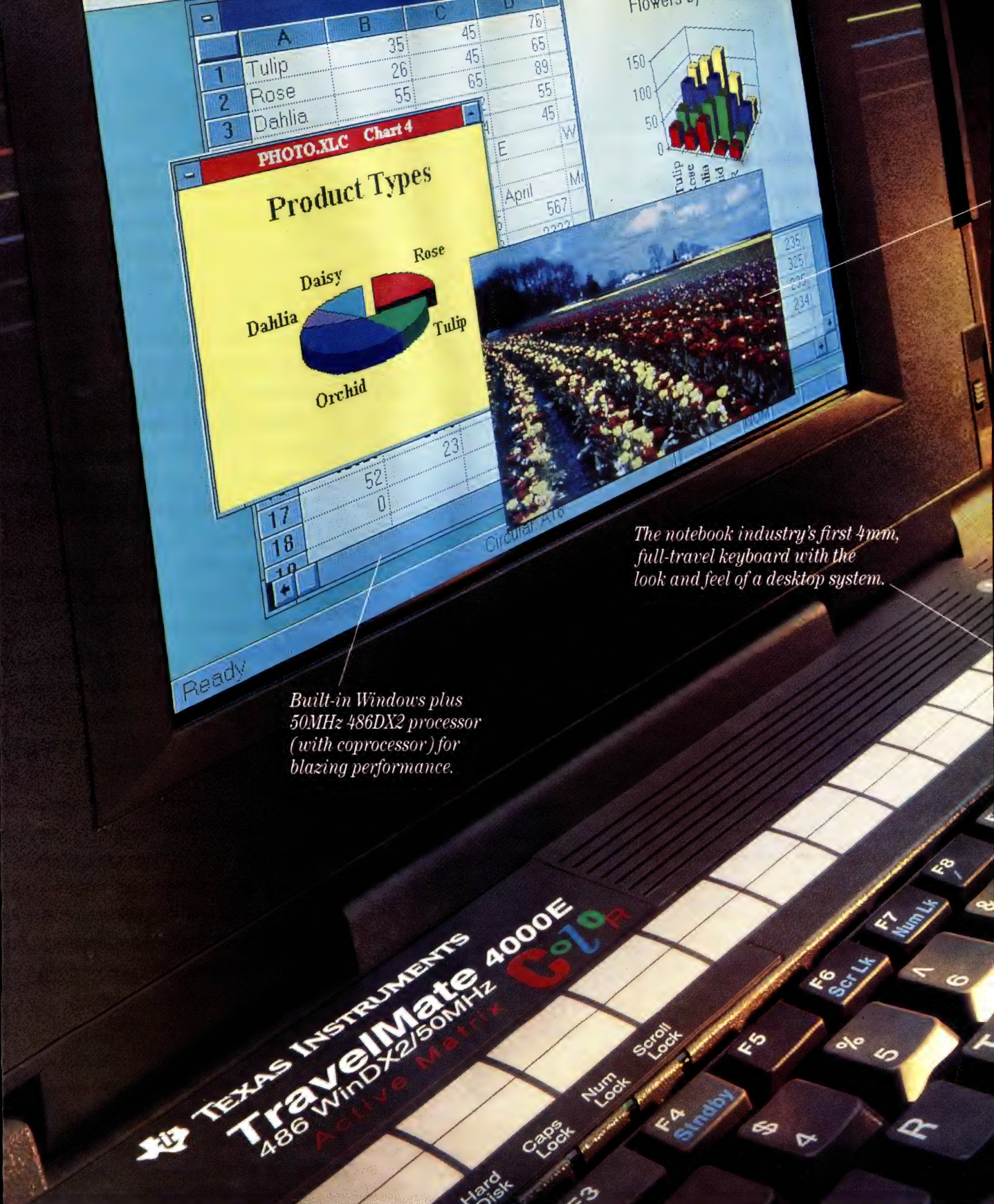
The Gateway 2000 ColorBook features a very bright, very readable color display, yet it uses economical dual-scan passive-matrix screen technology. The ColorBook features a trackball that slides out from the front of the case, as well as a removable hard disk. The Gateway 2000 ColorBook is available with CPUs ranging from a 486SX/25 to a 486DX/33, and with hard disk capacities ranging from 80MB to 170MB.



The Intelligent Notebook Systems Model 8200 Series notebook, when combined with its docking station, is another interesting multimedia package. The docking station includes a CD-ROM player, two built-in speakers, a Diamond Stealth Pro VLB video card, a Creative Labs Sound Blaster 16 sound card, and an Ethernet LAN card. The notebook comes with a 486DX2/66 CPU and a 340MB hard disk and features an active-matrix color display.



If NCR Corp.'s Safari 3180 looks a bit like the NEC UltraLite Versa 33C, there's a very good reason: NEC manufactures this model for NCR. The 486SL/33-based Safari 3180 has a removable, reversible display; a removable hard disk; and a floppy disk that can be traded for an additional nickel hydride battery. NCR offers the unit with a 180MB or 250MB hard disk and a monochrome, an active-matrix color screen, and even a pen-based display.

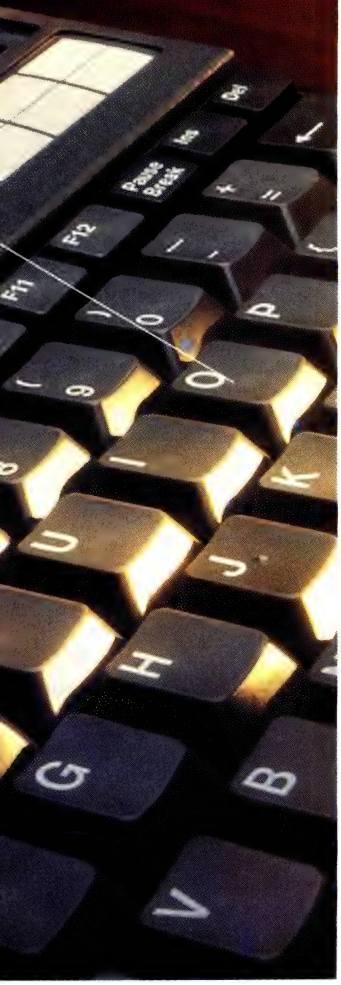


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New TI TravelMate™ 4000E WinDX2™/50 Active Matrix Color

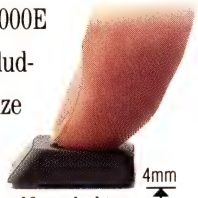
ACTIVE COLOR. 486DX2 50MHz POWER. WINDOWS IN 15 SECONDS. HEY, WHAT ARE YOU WAITING FOR?



If you've been waiting for an active matrix color notebook with true desktop power, your wait is over. Thanks to the new TravelMate 4000E WinDX2/50 Active Matrix Color notebook from Texas Instruments.

With 256 brilliant, simultaneous colors and a 50MHz 486DX2 processor, this powerhouse doesn't just whisper color, it screams it.

And yet the TravelMate 4000E weighs a mere 6.2 pounds, including battery. This convenient size and weight gives you more performance* than the leading 486 notebooks.



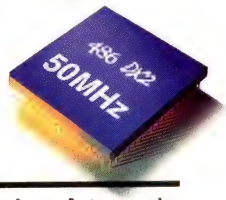
New, desktop-like keyboard with separate function keys.

Thanks to the built-in Windows 3.1 and useful TI utilities, you can power up to Windows in just 15 seconds. And the TravelMate 4000E is Windows NT-compatible. With 4MB of main memory, expandable to 20MB, you're ready for today's and tomorrow's software.

Using the mouse on the TravelMate 4000E is a snap. The Microsoft BallPoint™ mouse with QuickPort™ connection snaps on and off and needs no cable, giving you more flexibility and better ergonomics than a built-in mouse. With the industry's first 4mm, full-travel keyboard, the TravelMate 4000E gives you the feel of a desktop.

If you work on the go, you'll also go for the rugged 200MB hard disk drive, the high-speed video bus and 1MB of video RAM, as well as the full range of connectivity options – snap-on modules for Ethernet® LANs, SCSI-compatible devices and an internal 14,400 bps V.32 bis modem with 9,600 bps send/receive fax capability.

50MHz DX2 processor with coprocessor provides desktop performance in a notebook.



Of the leading active matrix color notebook manufacturers, only TI offers the desktop performance of a 50MHz DX2 processor.

Active Color Notebook	*Weight (lbs.)*	*486 Processor*	*Speed*	*Coprocessor*
TravelMate 4000E	**6.2**	**DX2**	**50MHz**	**Yes**
Toshiba T4600C	6.9	SL	33MHz	Yes
Compaq LTE Lite 4/33c	6.5	SL	33MHz	Yes
IBM ThinkPad 720C	7.6	SLC2	50MHz	No

Texas Instruments offers over 10 models of 486 notebooks for you to choose from.

TI TravelMate 486DX2 Notebooks



For more information about the only 486 notebook family that won five Editor's Choice awards in PC Magazine's August issue, call *1-800-527-3500*.

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Smaller, Lighter, Brighter:

Display Technology Looks Forward to Video

by Jeffrey Greenberg

Restricted by space and weight, and hindered by the lack of a constant power supply, notebook computers exemplify the trade-offs involved in portable PCs. Aim for a sharper, brighter display and size, weight, and especially battery life will inevitably suffer. Passive-matrix monochrome displays are lighter and use less power, but their quality pales in comparison with the quality of high-end active-matrix color panels. Several new technologies promise improvements on all fronts and signal the arrival of smaller, better screens that use less power.

An image on a passive-matrix VGA display is produced one pixel at a time. A screen's 300,000 pixels—small blocks on a VGA display's 640-by-480 grid that produce the screen's image—are selectively turned on to make them opaque or left off to leave them clear. For example, to activate a set row of pixels, you must address it while leaving those rows above and below it blank. This is accomplished with drivers that select each individual row. As a result, each row—and therefore each pixel—is only controlled 1/480th of the time.

To reduce the shimmering or pulsing caused by this oscillation, a liquid crystal material with a response time of approximately 300 milliseconds is used. The liquid crystal's slow speed allows it to respond to the average voltage over multiple frames, which reduces the flickering associated with the on-off-on cycle that is caused by row-at-a-time addressing.

TOO SLOW FOR VIDEO

The result of this compromise is that liquid crystal is too slow to keep up with moving images such as video, and at times even the mouse arrow. Also, each pixel loses its opacity as soon as the electrical charge is removed, preventing the pixel from maintaining a deep black color. This limits the contrast ratio of passive-matrix displays to about 12 to 1. Finally, the way the pixels are networked leads to shadow and ghost images.

To reduce the effects of the weaknesses inherent to standard passive-matrix displays, engineers have developed dual-scan passive-matrix technology, which divides the matrix into two horizontal segments, comprising 240 rows each. The two halves are operated simultaneously, doubling the time that each row and pixel are controlled. The contrast ratio is raised to about 18 to 1, and the response time is cut in half—fast enough to track a mouse arrow, but still too slow for video.

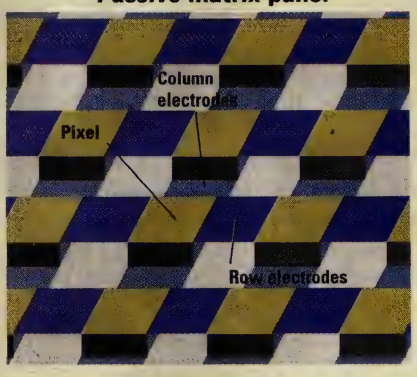
Taking this concept a step further, active-addressed passive-matrix screens address rows one at a time by using custom ASIC (application-specific integrated circuit) chips to calculate a series of 256 voltage patterns that are applied to the entire matrix. As a result, the contrast ratio can be as high as 60 to 1 with a response rate of 50 ms. The first active-addressed displays should appear in 1994 and cost approximately 30 percent more than passive-matrix displays currently on the market.

Active displays eliminate the problems associated with the shared-row-and-column addressing that is done with passive-matrix displays. In this arrangement, each pixel has its own dedicated drive transistor or switch (see the accompanying diagram). A thin film of these transistors is built directly on the glass that houses the liquid crystal display. Since each pixel is controlled by a dedicated transistor, there is no need to use slow liquid crystal. This results in a response time of 35 ms and a contrast ratio of 100 to 1.

On the downside, this technology requires an extraordinary level of sophistication. A color thin-film transistor (TFT) display contains 921,600 transistors—as many active elements as a 486SX processor. These screens measure up to 10.4 inches diagonally (most, however, are limited to 9 inches) and can add $1,000 to the cost of a notebook. Right now,

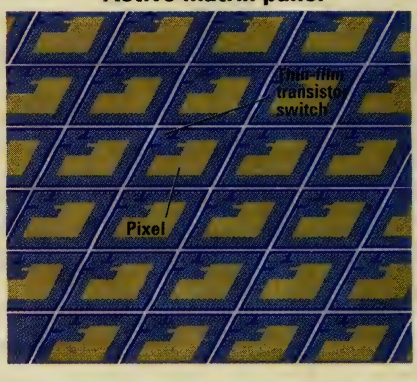
How Liquid Crystal Displays Work

Passive-matrix panel



A passive-matrix display responds to the average voltage from row and column electrodes.

Active-matrix panel



Active-matrix uses a switch at each pixel, resulting in higher contrast and a faster response.

these panels are in very short supply, but new developments in this segment of the market should increase capacity.

Display Technology (DTI) is a Japan-based joint venture of IBM and Toshiba that manufactures what many acknowledge as the best screens. The company has been plagued by low yields, which have created shortages. DTI's production facility is in the process of being upgraded, which should eventually address this problem. And Panasonic also has plans to join the big-screen market in the near future.

The built-in layers of a color LCD panel act as filters that let only certain colors of light pass through specific areas of the display. As a result, color LCD panels require a source of light. The earliest portable computers used reflective displays that relied on ambient light reflected through the LCD to illuminate the panel. They were inexpensive to make and required no additional power for lighting. Viewing quality, however, was compromised in the name of simplicity. However, these panels were good for outdoor use and in applications where long battery lives and light weights were more important than high-quality screen images.

SIDELIT OR BACKLIT

In order to provide a brighter display, manufacturers now place miniature fluorescent tubes behind or on the side of an LCD panel. Sidelit systems, which put the light bulbs at each edge of the screen, can be made thinner than backlit systems. In a twist that borrows from two technologies, Fujitsu, IBM, NEC, and Toshiba have begun using a lighting technique that combines the advantages (and disadvantages) of reflective displays with sidelighting. These new *transflective* displays have reflective surfaces and sidelights that users can turn on or off. Unfortunately, these displays tend to have lower contrast ratios than comparable sidelit displays.

LCD screens are extremely inefficient in their use of light. A typical TFT color display lets only 4 percent of the light pass through it to the viewer. More advanced materials and bonding techniques will most likely increase the efficiency of these screens over time. Meanwhile, efforts are being made to manage light more efficiently. 3M Corp. has developed a film that focuses the light so that more of it is aimed directly at a viewer's eyes. Display Engineering has developed a backlighting system that has this light-management capability built in.

Today's new technologies may lead to tomorrow's better notebooks, which will most likely offer the following features:

- Larger screens. Though more products are expected in the 10.4-inch range, larger screens are unlikely, because of the limitations of engineering a keyboard into a notebook.
- Lighter screens. Casio is developing a flexible LCD panel that uses plastic instead of glass to reduce system weight. This technology may migrate to PCs in 1994, reducing system weight.
- Higher resolutions. The standard for desktop-PC resolution has moved from 640-by-480 past 800-by-600 to 1,024-by-768. The standard for portable-PC resolution is next. Graphics applications require high resolution and often require high-contrast ratio and color, making active color an increasingly popular choice for these applications.
- More colors. Today's TFT screens can typically display 256 simultaneous colors out of a palette of 512 to 4,096 colors.

Though those capacities are sufficient for most use, it is inadequate for video, where 16.7 million colors are required. The first video notebook is the IBM ThinkPad 750C. With an add-on module, this system can receive and display television images, an advance that should ease the transition to integrating video into presentations. But it may have the side effect of diverting the traveling executive away from work, letting him or her watch the ball game on a notebook at 30,000 feet.



FACT FILE

Commax Smartbook

Commax Technologies Inc., 2031 Concourse Dr., San Jose, CA 95131; 800-526-6629, 408-435-5000; fax, 408-435-5005

List price: $4,002.

Tested configuration: 121MB Conner CP-2124 IDE hard disk with 32K buffer; 1.44MB floppy disk; 4MB RAM; built-in trackball; 2,400-bps data, 9,600-bps send/receive fax modem; DOS 6.0; Microsoft Windows 3.1.

Options: 200MB hard disk upgrade, $144; 4MB RAM upgrade, $280; 16MB RAM upgrade, $1,420; docking station, $330; extra nickel cadmium battery, $92; internal 2,400-/9,600-bps fax modem, $134.

In short: A disappointing battery life of 1 hour 15 minutes mars an otherwise nice design.

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installable RAM. The reviewed 486DX2/66 Smartbook system with an active-matrix color display, 4MB of RAM, a 120MB hard disk, and a fax/modem card lists for $4,002. A monochrome version of the Smartbook costs half as much.

But rudimentary power-management features limited the 8.1-pound Smartbook to 1 hour 15 minutes on our battery test—a showing that ranked 29th among the scores of our 33 tested portables. If you buy this notebook, we suggest that you also plan to spend $92 for an extra battery—or two.

The system's center-mounted trackball sits just above the keyboard, a placement that makes it a bit difficult to use at times. And the brightness control is handled via number-key/function-key combinations rather than via the more common and easily manipulated wheels on or near the display. The unit has no PCMCIA slots.

The Smartbook showed uneven per-

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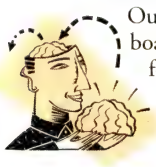
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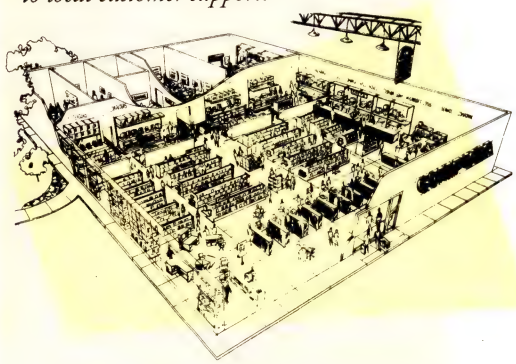
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formance, despite its sound mix of components. Its processor, DOSmark, and Graphics WinMark scores landed in the top ten—not surprising for a DX2/66-based system. Its DOS disk and Disk WinMark scores were merely midrange, however, and its DOS video and Winstone scores fell into the bottom of the test group. Unfortunately, the bottom line is that the tested Commax system simply did not live up to its significant potential.

Commax Technologies offers the Smartbook with a one-year warranty. On-site service costs $100 for the first year.—*GP*

Compaq Computer Corp.

Compaq Contura 4/25C

Like the Compaq LTE Lite 4/33C (also reviewed here), the Compaq Contura 4/25C has changed little since our last portable-PC roundup. The only apparent addition is its 120/240/W model label, which corresponds to the platform that it is set up for: DOS 6.0 and Microsoft Windows 3.1. Configured with a 14,400-bps fax/modem card, the passive-matrix Contura sells for $3,298.

Compaq Contura 4/25C

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Road warrior	GOOD
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

All the standard Contura equipment, such as a clip-on trackball and a dual-scan passive-color display, is included. The unit's travel weight comes in at under 8 pounds—which is about average.

With the Contura, you get about 1 minute less battery power than you do with the Compaq Lite, according to the results of our battery test. Nevertheless, the Contura can last for more than 3 hours on a charge.

The Contura posted a remarkably low Winstone score of 7.7. In comparison, the Compaq Lite posted a score of 20.9. The unit fared particularly poorly on our DOS video and Graphics WinMark tests, placing 29th and 31st, respectively, out of 33 portables. Its processor, DOS disk, and DOSmark scores were more consistent with other portables in its 25-MHz CPU class, however.

Given the success of the Contura line, one can guess that Compaq sees little reason to alter a thriving product. But the Contura is ripe for some changes. Namely, the company should consider incorporating PCMCIA slots to open up expansion possibilities. Since the line isn't meant for desktop-replacement duties, local-bus technology is less of an issue here, but it would certainly improve overall peripheral performance.

The Contura comes with a 3-year warranty. On-site service for the first year is included.—*GP*



FACT FILE

Compaq Contura 4/25C

Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269-2000; 800-345-1518, 713-378-8820; fax, 713-378-1442

List price (estimated): $3,398.

Tested configuration: 120MB Compaq IDE hard disk, 1.44MB floppy disk, 4MB RAM, mouse, SpeedPAQ 144 cellular 14,400-bps data/fax modem, DOS 6.0, Microsoft Windows 3.1.

Options: 209MB hard disk upgrade, $752; 4MB RAM upgrade, $262; 8MB RAM upgrade, $526; 16MB RAM upgrade, $1,559; nickel hydride battery pack, $121; enhanced nickel cadmium battery pack, $84; auxiliary battery, $24; external battery, $93; SpeedPAQ 144 modem, $549; enhanced keyboard, $89; external numeric keypad, $82; battery charger/discharger, $93; AC adapter, $93; 12-volt battery adapter, $95; Contura active-matrix display option kit, $2,499.

In short: A 3-hour battery life and a rich set of standard features balance out uneven performance.

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Compaq Computer Corp.

Compaq LTE Lite 4/33C 120/240/W

Apart from an upgrade to the SL/33 CPU, little has changed with the $5,167 Compaq LTE Lite 4/33C since it was last reviewed in our August issue. This PC is made for docking, and its prime selling points continue to be heavy-duty construction and Compaq's reputation for high-quality service and support.

This enhanced version of the former LTE Lite 4/25C, also called the Model 120/240/W, includes a 9,600-bps data-only modem and is configured with 8MB of RAM. The *W* means it's Windows-ready and the *240* represents the added hard



FACT FILE

Compaq LTE Lite 4/33C Model 120/240/W

Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269-2000; 800-345-1518, 713-378-8820; fax, 713-378-1442

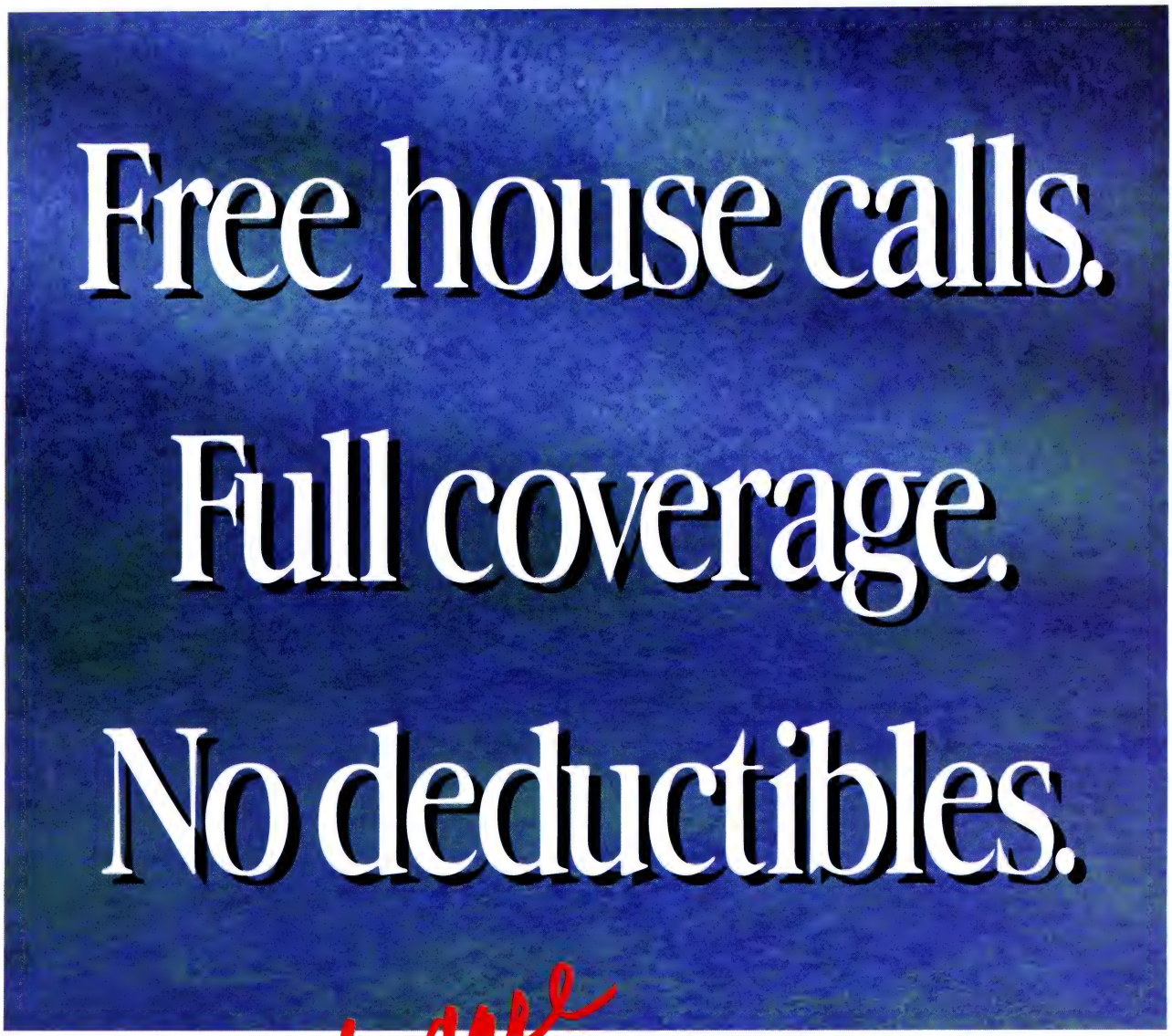
Estimated price: $5,167.

Tested configuration: 120MB Compaq IDE hard disk, 1.44MB floppy disk drive, 8MB RAM, mouse, 9,600-bps data-only modem, DOS 6.0, Microsoft Windows 3.1.

Options: 209MB hard disk, $752; 4MB RAM upgrade, $369; 8MB RAM upgrade, $849; 16MB RAM upgrade, $2,199; port replicator, $79; enhanced port replicator with built-in SCSI and Ethernet adapters, $299; nickel hydride battery, $187; nickel cadmium battery, $121; SpeedPAQ 144 cellular 14,400-bps data/fax modem, $549; enhanced keyboard, $89; external storage module, $165; CD-ROM adapter, $246; desktop expansion base, $599.

In short: The Compaq Lite had spotty performance results but excellent battery life.

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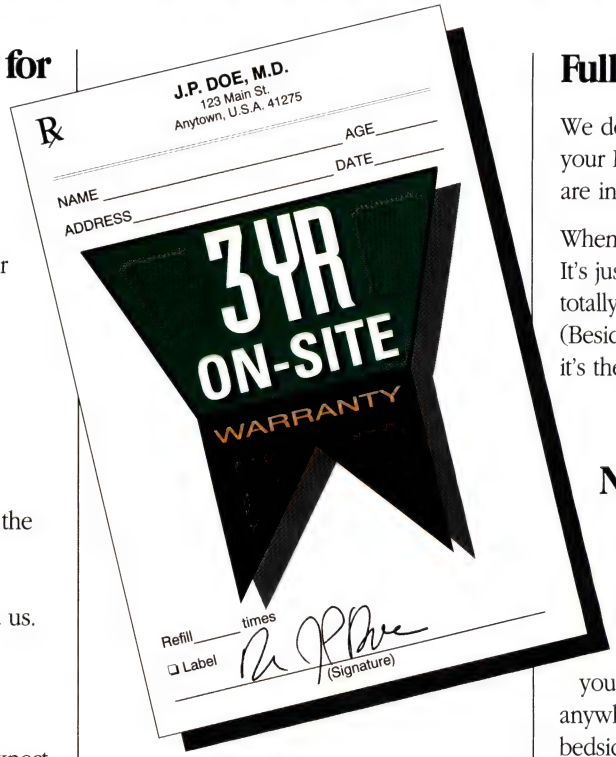
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- Intel486DX2/66
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- 5 Drive Bays
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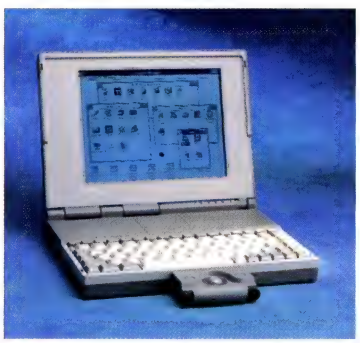
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- Local Bus Video
- Dual Video Display
- Front-mounting Cableless Trackball
- Enhanced Pre-loaded Software DOS 6.0, Windows 3.1, Bitfax, Tourguide, AT&T Mail AccessPLUS and on-line Windows documentation
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$3,280
or
$111/month



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- 6.8 lbs. (6.1 mono)
- 11.7" x 9.3" x 2.1"
- 9.5" TFT Active Color Removable Screen or 9.4" Mono Screen
- 4MB RAM (upgradable to 12MB)
- 1MB Video Memory
- 2 PCMCIA Slots (Type 2) or 1 Slot (Type 3)
- Local Bus Video
- Dual Video Display
- Trackball
- Enhanced Pre-loaded Software DOS 6.0, Windows 3.1, Bitfax, Tourguide, AT&T Mail AccessPLUS and on-line Windows documentation
- 3-year Warranty (first year on-site)

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disk capacity if you use DOS 6.0's disk doubling utility. Another version of the Compaq Lite, the model 209/418/W, priced at $4,699, is also available. This one comes without the modem but with 4MB of base memory and a 209MB hard disk.

Both versions give you active-matrix color technology packaged in a system that includes an upgradable flash ROM BIOS and fine power-management features. Travel weight for each unit is 8 pounds. The only shortcomings of these units are their lack of PCMCIA support and their 8.5-inch screens.

Compaq LTE Lite 4/33C

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Road warrior	GOOD
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

The Compaq Lite is starting to take performance hits from similarly configured local-bus portables. For instance, with regard to DOS video performance, the Compaq Lite ranks 31 out of the 33 systems tested. On its Disk Winmark and Graphics Winmark scores, the unit ranks at the bottom of its CPU class as well. On the other hand, this system came up with an excellent 3 hours 2 minutes on our Battery Rundown test. The highlight for the Compaq Lite was on our Winstone test, where it took ninth position among the entire test group.

Compaq backs this product with a three-year warranty.—*GP*

Compudyne Products

Compudyne 486DX2/66 Color Slimnote

The Compudyne 486DX2/66 Color Slimnote, with its powerful DX2/66 Intel processor, ought to be an impressive performer, but both its battery life and its Windows benchmark-test performance left something to be desired.

The Slimnote produced spotty test results. On our processor tests, it ranked an impressive sixth among all machines tested, but it was outperformed on those same tests by all but one DX2/66 portable and by two Texas Instruments systems with the less-capable DX2/40 and DX2/50 processors. The Slimnote stood in roughly the same position on the DOSmark and disk performance tests; it dropped further on the Winstone and Graphics Winmark tests, which suggests that the portable may be better suited for DOS applications than Windows functions.

Compudyne 4DX2/66 Color Slimnote

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Road warrior	FAIR
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	BELOW AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

Due to its power-processor, the Slimnote's battery performance was fair; the unit ran for 2 hours 3 minutes between recharges. Other DX2/66 portables ranged from less than 1 hour to over 2 hours. With a travel weight of 8.4 pounds, however, the Slimnote puts a power processor in a tight package. Compudyne offers the notebook for an attractive $3,999, but the system is lacking a PCMCIA expansion slot.

Aesthetics and ergonomics are not the Slimnote's strong suits either. The brightness-adjustment slide-bar for the 9.5-inch active-matrix screen has a tendency to stick. The keyboard has generously sized keys, but they lack positive feedback. The trackball, mounted in the panel in front of the keyboard, requires that the user remove his hands from the keyboard to move the cursor.

The Slimnote comes with a one-year warranty. One year of on-site service is available for an additional $99.—*SWP*



FACT FILE

Compudyne 4DX2/66 Color Slimnote

Compudyne Products, 15167 Business Ave., Dallas, TX 75244; 800-862-3099, 214-702-0055; fax, 214-888-5743

List price: $3,999.

Tested configuration: 212MB Toshiba MK2224FC IDE hard disk with 128K cache, 1.44MB floppy disk drive, 4MB RAM, built-in trackball, DOS 6.1, Microsoft Windows 3.1.

Options: 4MB RAM module, $230; extra nickel hydride battery, $149; 2,400-/9,600-bps data/fax modem, $200; numeric keypad, $60; extra AC adapter, $90; 12-volt battery adapter, $60.

In short: The Compudyne 4DX2/66 Color Slimnote, a high-end portable system, performed impressively on our benchmark tests under DOS while displaying below-average battery life with a time of just 1 hour 27 minutes.

449 ON READER SERVICE CARD

Digital Equipment Corp.

DECpc 425SLC

With the exception of the corporate labels, the dark-gray boxes holding the AST PowerExec 4/33SL ColorPlus and the DECpc 425SLC are nearly identical. The PowerExec and 425SLC share the same design, 8-pound travel weight, and pair of Type II PCMCIA slots, but J22 have different processors, hard disk options, and levels of all-around performance. The PowerExec uses an SL/33 CPU; the 425SLC uses the slower SL/25.

DECpc 425SLC

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Road warrior	EXCELLENT
Desktop replacement	GOOD

The 425SLC has an excellent keyboard design with lively feel, intuitive layout, and good key size (except for the top row, where the function keys are about the size of grains of corn). The trackball is contained in a pod that firmly attaches to the front of the machine's case just below the keyboard. Because the trackball is electrically connected via a four-pin plug, there are no annoying cables. But while the trackball is convenient, it can be awkward to use.

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CIRCLE 062 ON READER SERVICE CARD



FACT FILE

DECpc 425SLC

Digital Equipment Corp., 40 Old Bolton Rd., Stow, MA 01775; 800-722-9332, 508-493-5111; fax, 800-524-5624

List price: $3,999.

Tested configuration: Quantum Go-Drive 120MB IDE hard disk, 1.44MB floppy disk drive, 4MB RAM, trackball, DOS 6.0, Microsoft Windows 3.1.

Options: 200MB hard disk upgrade, $800; docking station, $379; docking port, $89; nickel hydride battery pack, $169; PCMCIA 14,400-bps fax modem, $549; numeric keypad, $79; battery charger, $49; extra AC adapter, $79; car battery adapter, $129.

In short: Similar in design to AST Research's PowerExec 4/33SL ColorPlus, the 425SLC portable manages to provide good performance and features in addition to almost 3 hours of battery life. Its active-matrix screen provides clean, crisp colors.

450 ON READER SERVICE CARD

The system's active-matrix screen is excellent, measuring 9.5 inches diagonally and offering clear, crisp color and excellent "viewability" from even extremely wide angles. Fortunately, the screen never seems to need adjustment; the positive/negative-style brightness- and contrast-adjustment buttons seem to have little or no effect on the quality of the screen's image.

The 425SLC's use of an SL/25 processor meant that the unit generally took a backseat to the 33-MHz PowerExec on all tests but the Graphics Winmarks, where the two systems tied. Both units had good battery life, with the 425SLC managing 2 hours 47 minutes. Digital Equipment Corp. offers what it calls Passport Service for $200. Should the system fail on the road, Digital will repair it and ship it to your next destination. The unit comes with a three-year warranty.—*Steve Potter*

HyperData Technology Corp.

HyperBook 3220SLC/33
HyperBook 3300DX2/50

The HyperData Technology Corp.'s HyperBook 3220SLC/33 and 3300-DX2/50 are certainly distinctive-looking notebooks. Their slate-gray bases and purple, turquoise, and mauve buttons, dials, and labels set them apart in terms of design.

The 8.2-pound 3300DX2/50, with its Intel 486DX2/50 CPU and active-matrix display, is a top-end machine for power users. The 7.8-pound 3220SLC, however, with its Cyrix CX486SLC/33 processor and dual-scan passive-matrix screen, trades CPU power for longer battery life.

Each screen offers adequate though not outstanding performance for its unit's price class. The active-matrix screen has richer colors than does the dual-scan passive display, but the latter is more than adequate.

The systems' keyboards are identical to one another; each offers a separate 16-key numeric keypad. Although this is a nice feature, the tradeoff is that the rest of the keyboard is cramped. The design's high point is the trackball, which is built into the bottom third of the base, below the keyboard. The large trackball offers good control.

HyperBook 3220SLC/33

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Road warrior	GOOD
Desktop replacement	FAIR

The lack of PCMCIA slots is partially offset by the availability of internal fax modems. The 3220SLC's RAM is expandable to 8MB; the 3300DX2/50's RAM can be expanded to 20MB.

The 3300DX2/50 was a high flier on our performance tests, finishing near the top in all but two categories: It took second place on the Winstone test, seventh on processor tests, third on Disk Winmark tests, and fourth on its DOSmark score.

The 3220SLC's performance was more in the midfield, reflecting the abilities of that system's Cyrix chip. The price of the high-flying performance that you get with the 3300DX2/50 system is dear, however. At $6,895, it is the costliest of all the machines we tested for this roundup. The 3220SLC sells for just $2,995.

HyperBook 3300DX2/50

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Road warrior	POOR
Desktop replacement	GOOD



FACT FILE

HyperBook 3220SLC/33

List price: $2,995.

Tested configuration: 130MB Toshiba MK2124FC IDE hard disk with 32K buffer, 1.44MB floppy disk drive, 8MB RAM, 2,400-/9600-bps data/fax modem, DOS 6.0, Microsoft Windows 3.1.

Options: 340MB hard disk upgrade, $540; with 4MB RAM, $400 less; extra nickel cadmium battery, $60.

HyperBook 3300DX2/50

List price: $6,895.

Tested configuration: 212MB Toshiba MK2224FC IDE hard disk with 128K buffer, 1.44MB floppy disk drive, 20MB RAM with 128K of external cache, 2,400/9,600-bps fax modem, DOS 6.0, Microsoft Windows 3.1.

Options: same as 3220SLC/33, except: with 4MB RAM, $2,100 less; with 8MB RAM, $1,700 less; with 12MB RAM, $1,300 less.

In short: The 3220SLC2 and 3300DX2/50 HyperData notebooks are short on battery life and high on price. But both of these color portables stand out in terms of design.

HyperData Technology Corp., 809 S. Lemon Ave., Walnut, CA 91789; 909-468-2955; fax, 909-468-2961

452 ON READER SERVICE CARD

On our Battery Rundown test, the HyperBooks offer a trade-off of performance versus battery time: the 3220SLC logged a time of 2 hours 27 minutes, but the 3300DX2/50 finished dead last on this test, with a time of 51 minutes. Both units come with a one-year warranty; on-site service is not available through the vendor.—*SP*

IBM Personal Computer Co.

IBM ThinkPad 350C

There are many similarities between the $2,499 IBM ThinkPad 350C and the IBM ThinkPad 750C high-end notebook. The 350C's anthracite-colored case shares its color and shape with the more expensive machine's case. The two units share a spacious keyboard design with a lively feel and the unique, easy-to-use TrackPoint II "eraser-in-the-keyboard" pointing system. The systems differ, however, in terms of weight, display, and price: The 350C, a value leader, is lighter, has a passive-matrix screen, and costs $2,000 less than its high-end counterpart.

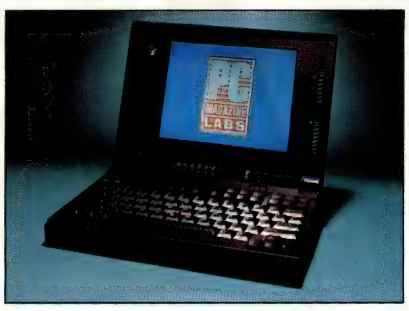
IBM ThinkPad 350C

SUITABILITY TO TASK	
DOS aplications	GOOD
Windows applications	GOOD
Road warrior	GOOD
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

Still, you don't get what you don't pay for. You won't get the 750C's superb 10.4-inch, active-matrix screen or its SL/33 processor. You must settle for a smaller—though quite good—9.7-inch, passive-matrix color display and an SL/25 CPU. On the other hand, the 350C fared well on performance tests, outpacing the other SL/25-equipped models on some of the benchmark tests. On the Winstone and DOS video tests, it outperformed even the 750C. In fact, the 350C's only shortcoming is its battery life; it lasted for only 2 hours 2 minutes, a below-average time for today's color notebook.

The 350C has an advantage also in terms of weight, because it uses a small, plug-in transformer instead of a large, inline power brick. Travel weight is kept down to a svelte 6.4 pounds. The unit comes also with a PCMCIA Type II slot and an optional internal modem, an impressive combination.

IBM provides a one-year on-site warranty that includes two-way shipping for repairs; a year of on-site service costs $40. The machine comes loaded with IBM DOS 5.02 and Prodigy, but not with Windows, so be sure to figure in that extra cost when making comparisons.—*SP*



FACT FILE

IBM ThinkPad 350C

IBM Personal Computer Co., Rte. 100, Somers, NY 10589; 800-772-2227; fax, 800-426-4329

List price: $2,499

Tested configuration: Maxtor 25128A 127MB IDE hard disk with 32K cache, 1.44MB floppy disk drive, 4MB RAM, DOS 5.02, Prodigy.

Options: 8MB RAM upgrade, $499; 16MB RAM upgrade, $2,399; nickel hydride battery pack, $175; 9,600-bps fax modem, $499; AC adapter, $85; wall-mount adapter, $65.

In short: A compact, light, and powerful machine with an adequate passive-matrix color screen, the ThinkPad 350C is the perfect little brother to IBM's far more expensive ThinkPad 750C. Its only significant shortcoming is its battery life: barely two hours on our Battery Rundown test.

453 ON READER SERVICE CARD

IBM Personal Computer Co.

IBM ThinkPad 750C

If you thought IBM hit the notebook-technology ceiling with its ThinkPad 720C, you're in for a pleasant surprise. The 750C retains the 10.4-inch, active-matrix screen and the great keyboard, but it adds built-in audio circuitry and more—in a lighter, 7.8-pound package.



FACT FILE

IBM ThinkPad 750C

IBM Personal Computer Co., Rte. 100, Somers, NY 10589; 800-772-2227; fax, 800-426-4329

List price: $4,699.

Tested configuration: IBM WDA-2160 171MB IDE hard disk, 1.44MB floppy disk drive, 4MB RAM, DOS 6.1, Prodigy.

Options: 340MB hard disk, $1,299; external floppy disk attachment kit, $135; 8MB RAM upgrade, $905; 16MB RAM upgrade, $1,999; docking station, $899; port replicator with PCMCIA slot, $299; port replicator, $109; nickel hydride battery pack, $199; 14,400-bps PCMCIA fax modem, $595; battery quick charger, $259; AC adapter, $159; upgrade kit to pen screen, $1,399.

In short: While the IBM ThinkPad 750C wasn't the performance leader in this review, its terrific screen, excellent keyboard, and clever design make it a traveling companion without equal.

453 ON READER SERVICE CARD

The 750C is a good choice for travelers—if you have the $4,699. The unit, which includes a headphone jack, voice-annotated online help, and a Type-III PCMCIA slot, might have you asking, "What doesn't it have?" Its docking station offers a CD-ROM drive and stereo speakers, and a video module turns the 750C into a video monitor. The keyboard swivels up for easy access to its removable floppy disk drive, hard disk, nickel hydride battery, and memory slot.

The keyboard has the same precise feel that the 720C's does and it also has the now-familiar TrackPoint II pointing device. Arrow cursor-control keys are conveniently placed on the bottom-right corner of the keyboard, but other cursor keys are located on the upper right—a

design that takes a little getting used to. The 750C was not a performance leader; rather, it consistently placed in the middle of the test pack. The unit's low Winstone score can be attributed to its 4MB of RAM; we suggest a minimum of 8MB for running Windows. Even though the 750C had the largest screen in this group, it still logged an excellent battery life of 3 hours 38 minutes.

IBM ThinkPad 750C

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Road warrior	EXCELLENT
Desktop replacement	EXCELLENT
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

The key drawback of the 750C is that it's hard to get your hands on one. An upcoming passive-matrix color ThinkPad 750Cs should take some pressure off IBM dealers. IBM offers a three-year parts-and-labor warranty and a 30-day money-back policy.—*Robert S. Anthony*

Logisys

Logisys Log-486TFT
Logisys Log-486DUA

Both the $3,519 Logisys Log-486TFT and the $2,380 Logisys Log-486DUA are low-cost clone notebooks that are manufactured in Taiwan by Veridata Technologies Inc. and wear one of a number of corporate nameplates by the time they reach the states.

Both units comes in sleek gray cases and have Cyrix 33-MHz 486SLC processors and built-in math coprocessors, a combination that favors long battery life over high-powered performance. Each has an average-size AC power adapter and weighs under 8 pounds.

Logisys Log-486DUA

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Road warrior	GOOD
Desktop replacement	FAIR

The Log-TFT

SUMMARY OF FEATURES CONTINUES

Color Portables

List price (tested configuration) Not all portables are available in comparable configurations. We report the price for the tested configuration of each system.

Dealers/Direct-distribution channe Various machines are sold directly through mail order, through dealers, or through company-owned stores and superstores.

System weight/Travel weight System weight includes the weight of the battery. The travel weight adds that of the AC adapter brick and power cord.

Keys: total, function, cursor The table describes each portable's built-in keyboard: the total number of keys, the number of function keys, and the number of cursor keys.

Type of pointing device installed A pointing device can be free-standing (a normal serial or PS/2-style mouse), built-in (a trackball installed in the case), clip-on (a device that clips onto the system's case and runs via a cable), or snap-on (similar to a clip-on, but using a special port and requiring no serial cable).

The **BIOS version** (or date) can affect the system's performance on our benchmark tests.

System shadowing/Video shadowing Shadow RAM is a technology that loads system BIOS or video BIOS from slower ROM into faster RAM on boot-up, offering enhanced performance speed.

Port replicator/docking station A port replicator recreates the I/O ports and can easily be removed without disconnecting peripherals. A docking station provides additional ports and space for expansion cards.

PCMCIA slots accept removable credit card-size I/O devices such as modems or cards for expansion memory or for nonvolatile static RAM for storage. There are currently three standard versions: Type I, Type II, and Type III.

Internal modem installed indicates the type of modem sent with the computer. Maximum data and fax communication speeds are listed; all modems have send and receive capabilities.

The **chip set and video memory** determine the maximum external resolution and the number of simultaneous colors an external monitor can display at that resolution. Decreasing the resolution setting usually increases the maximum external colors. Active-matrix displays are brighter, provide richer colors, and are easier to view at an angle than passive-matrix screens are.

This table includes each system's **rated battery life** as reported by the vendor. PC Magazine Labs independently tests the battery life with power conservation features enabled (ZDigit battery life), and we report the results here and in our benchmark test section. We also indicate the battery charge time while on and off as reported by the vendor.

Battery weight, amp/hour rating We report the battery's weight in pounds, as well as how long that battery is rated to deliver a steady current of 1 ampere. You'll find wide discrepancies among the sizes and power ratings of batteries included in the units reviewed in this issue.

The systems in this roundup all include **power-conservation features**, such as automatic display dimming or blanking, automatic hard disk power-down, slowing or halting the CPU, and peripherals power-down for cutting off power to the I/O ports when the machine is not in use. More advanced **power-management features** include standby mode (in which the system preserves its current state in memory, usually via a secondary battery) and hibernation (in which the system's state is written to the hard disk, ensuring that the system retains information if battery power fails).

Warranty All systems reviewed come with a one-year parts-and-labor warranty or better.

First year on-site service charge Some vendors offer true on-site service for their portable systems. In some cases, the service is included as part of the standard warranty.

Each system has an **FCC Class B identification number**, which means it has sufficiently low radio-frequency emissions to be used in the home. To verify any system's status, you may dial up the Public Access Link, the Federal Communications Commission's own bulletin board service, at 301-725-1072.

AUSTIN has what DELL wants for Christmas.



It's true.

"Dell Computers — and others — had a great idea: produce a compact notebook with blazing speed and a large capacity hard disk.

Sounded good to us. Only difference is, we made it happen! Our Ultimate Notebook features a 66 MHz processor with a 340 MB hard drive — something Dell just cannot seem to deliver.

But the real reason we pushed ahead with this product is because you, our customers, told us that's what you wanted. Maybe unlike some others, when our customers talk, we listen!

Hope you enjoy this terrific notebook!"

David Scull, President/CEO
Austin Computer Systems

intel inside

Flexible Display Options. *Austin's new Dual Scan color systems deliver bright, vivid color at a cost-effective price. Choose active-matrix color for the most demanding applications, or razor-sharp monochrome when color isn't needed.*

Accelerated Video. *32-bit local-bus video accelerator with 1 MB of VRAM — found in the hottest desktops ... and on all Austin Notebooks! Plus, simultaneous CRT and LCD display.*

PCMCIA Expandability. *Two PCMCIA slots takes two Type II or one Type III device for fax modems, LAN adapters, and more.*



Rugged, high-speed glass media hard drives. *Choose from 130, 213 or 340 MB — the largest on the market!*

Integrated Trackball.

Large ergonomic front-center trackball for exceptional ease of use. No need to fumble with awkward clip-on or pull-out pointing devices.

MICROSOFT WINDOWS READY-TO-RUN

energy

Popular Austin 486 Notebook Configurations
32-Bit Local Bus Video Accelerator with 1 MB RAM

$1,899	NEW! $2,199	NEW! $2,999	$4,499
486SX-25	486SX-25 Dual Scan Color	486DX2-66 Dual Scan Color	486DX2-66 TFT Color
4 MB RAM Standard	4 MB RAM Standard	8 MB RAM Standard	8 MB RAM Standard
130 MB Hard Drive	130 MB Hard Drive	213 MB Hard Drive	340 MB Hard Drive

Memory	32 MB RAM maximum	**Battery Life**	2 to 5 hours
I/O Ports	1 Parallel, 2 Serial, SVGA, External Keyboard	**Preinstalled Software**	MS-DOS 6.0, Microsoft Windows 3.1
Diskette Drive	3.5", 1.44 MB	**Dimensions**	11.1" x 8.58" x 2.0"
Power Usage	<10 watts in Standby Mode, conforms to EPA Energy *Star guidelines*	**Weight**	6.3 lbs
		Warranty	1 year



Happy Holidays!

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CIRCLE 156 ON READER SERVICE CARD

SUMMARY OF FEATURES

Color Portables

Products listed in alphabetical order ■ = YES □ = NO	AcerNote 730C	AcerNote 750C	Aspen Aura	AST Bravo NB 425s ColorPlus	AST PowerExec 4/33SL ColorPlus	Austin 425-130	BSI NP846T Active Color Notebook	CAF AquaLITE 486DX/33C
List price (tested configuration)	$2,449 (estimated)	$4,149 (estimated)	$2,695	$3,549 (estimated)	$4,400 (estimated)	$2,999	$4,200	$2,899
Processor type and speed	Intel 486SX/25	Intel 486SL/25	Intel 486DX/33	Intel 486SX/25	Intel 486SL/33	Intel 486SX/25	Intel 486DX2/66	Intel 486DX/33
Hard disk capacity	119MB	209MB	213MB	136MB	204MB	130MB	252MB	130MB
Dealers/Direct-distribution channel	■■	■■	■■	■□	■□	■■	■■	■□
Dimensions (HWD, in inches)	2.3 x 11.3 x 8.5	2.3 x 11.3 x 9	2.3 x 11.8 x 8.8	1.8 x 11.8 x 8.8	2 x 11.5 x 8.5	2 x 11 x 8.5	2.8 x 11 x 9	2.3 x 11.8 x 8.3
System weight/Travel weight (pounds)	6.7, 7.9	7.3, 8.6	6.6, 8	6, 6.6	6.8, 8	6.7, 7.9	6.8, 8.5	7, 8.4
Display area and diagonal (inches)	5.8 x 7.5, 9.5	5.8 x 7.8, 9.5	5.8 x 7.8, 9.5	5.3 x 6.8, 8.5	5.8 x 7.8, 9.5	5.8 x 7.5, 9.5	5.8 x 7.8, 9.5	5.8 x 7.5, 9.5
Keys: total, function, cursor	85, 12, 8	85, 12, 8	84, 10, 8	82, 12, 6	82, 12, 8	85, 10, 8	86, 12, 8	83, 10, 8
Type of pointing device installed	Built-in	Built-in	Built-in	Built-in	Snap-on	Built-in	Built-in	Built-in
Motherboard								
Motherboard/chip set manufacturer	Acer/Intel	Acer/Intel	Dual/C&T	AST/Intel	AST/Intel	Arima/ACC	BSI/ETEQ	Chicony/C&T
BIOS version (or date)	Phoenix 1.03	Acer (5/6/93)	AMI (5/19/93)	AST (8/4/93)	AST 2.21	AMI 1.30	Award 3.2-B	Phoenix Q3.0702
Setup in ROM/Password in ROM	■■	■■	■■	■■	■■	■□	■□	■■
System shadowing/Video shadowing	■■	■■	■□	■□	■■	■■	■■	■■
Memory and Disk Drives								
Installable RAM	4MB–12MB	4MB–20MB	4MB–20MB	4MB–20MB	4MB–32MB	4MB–32MB	4MB–20MB	Up to 20MB
User-installable	■	■	■	■	■	■	■	■
External processor RAM cache	None	None	None	None	None	None	None	None
Available hard disk sizes	80MB–120MB	120MB–200MB	120MB–340MB	170MB	200MB–340MB	130MB–340MB	120MB–250MB	86MB–213MB
I/O and Expansion								
Parallel, serial, mouse, expansion ports	1, 1, 1, 0	1, 1, 1, 0	1, 1, 1, 1	1, 1, 1, 0	1, 1, 1, 1	1, 2, 0, 1	1, 1, 0, 1	1, 1, 0, 1
High-speed parallel/serial support	□□	□□	□□	■□	■■	□■	□□	□□
Port replicator/Docking station	□□	□□	□■	□□	■■	□■	□■	□■
PCMCIA slots	None	Two Type II or one Type III	None	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	Two Type II or one Type III	None
Internal modem installed	2,400-/9,600-bps fax	2,400-/9,600-bps fax	None	None	None	None	14,400-bps fax	2,400-/9,600-bps fax
Video								
Screen/video chip set manufacturer	Sharp/C&T	Toshiba/Cirrus	Toshiba/C&T	Sharp/C&T	Hitachi/WD	NEC/WD	Toshiba/Cirrus	Epson/C&T
Simultaneous external display	■	■	■	■	■	■	■	■
Maximum internal resolution	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
Maximum internal colors	256	256	256	256	256	256	256	256
Maximum external resolution	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
Maximum external colors	16	16	16	256	256	256	16	256
Active matrix	□	■	□	■	■	■	■	□
AC Adapter and Battery								
AC adapter size (HWD, in inches)	1.3 x 2.5 x 5.8	1.5 x 2.5 x 6	1.5 x 5.8 x 2.5	1.5 x 2.8 x 4.5	1.8 x 2.8 x 4.6	1.8 x 5.5 x 3	2.3 x 3.3 x 6.5	1.5 x 2.8 x 5.8
Rated battery life (hours)	3	3	3	3	6	2	2.5	3
ZDigit battery life (hours:minutes)	2:49	3:14	1:51	2:02	3:00	3:14	2:27	2:11
Charge time while on, off (hours)	N/A, 2	N/A, 2.5	3, 1.5	8, 2	1.5, 1	N/A, 1.5	2, 2	8, 4
Battery weight, amp/hour rating	1.2 lbs, 4.6Ah	1.4 lbs, 9.6Ah	1.1 lbs, 2Ah	1 lb, 2.2Ah	1.5 lbs, 2.2Ah	1.3 lbs, 3.5Ah	1.4 lbs, 2Ah	1.6 lbs, 2.8Ah
Display/hard disk power-down	■■	■■	■■	■■	■■	■■	■■	■■
CPU/peripherals power-down	■■	□□	■□	■■	■■	■□	■□	■■
Standby/Hibernation	■■	■□	■■	■□	■■	■■	■□	□■
Miscellaneous								
DOS, Windows version included	6.0, 3.1	6.0, 3.1	6.0, none	6.0, 3.1	6.0, 3.1	6.0, 3.1	6.0, none	6.0, 3.1
Warranty	1 year	1 year	1 year parts, 2 years labor	1 year	1 year	1 year	1 year	1 year
First-year on-site service charge	Included	Included	N/A	N/A	N/A	N/A	N/A	N/A
FCC Class B identification number	GQ8730C	GQ8750C	SKD-4000	HFSL42C	DJKPWRE486-33SL	ID4PN486TC	FMA6500C	E8HNB9600C

N/A—Not applicable: The product does not have this feature.

AMI–American Megatrends Inc., C&T–Chips & Technologies Inc., DTI–Display Technologies Inc., MEI–Matsushita Electric Industrial Co. Ltd., MTC–Mars Technology Corp., WD–Western Digital Corp.

CAF AquaLITE 486DX/33T	Commax Smartbook	Compaq Contura 4/25C	Compaq LTE Lite 4/33C	Compudyne 4DX2/66 Color Slimnote	DECpc 425SLC	FutureTech FutureMate 433nV	HyperBook 3220SLC/33	HyperBook 3300DX2/50
$4,199	$4,002	$3,298 (estimated)	$5,167 (estimated)	$4,499	$3,999	$3,729	$2,995	$6,895
Intel 486DX/33	Intel 486DX2/66	Intel 486SL/25	Intel 486SL/33	Intel 486DX2/66	Intel 486SL/25	Intel 486DX/33	Cyrix Cx486SLC/33	Intel 486DX2/50
121MB	120MB	120MB	120MB	212MB	120MB	121MB	130MB	213MB
■□	■□	■■	■■	■■	■■	■■	■□	■■
2.3 x 11.8 x 8.3	2 x 11.5 x 9	2.3 x 11.3 x 8.8	2.3 x 11 x 8.5	2 x 11 x 8.5	2 x 11.5 x 8.3	2.3 x 11 x 9	2.3 x 11.5 x 8.5	2.3 x 11.5 x 9
7.3, 8.9	6.6, 8.1	6.7, 7.8	6.7, 8	7, 8.4	6.7, 8	6.7, 8.4	6.4, 7.8	6.9, 8.2
5.8 x 7.8, 9.5	5.8 x 7.8, 9.5	5.8 x 7.5, 9.5	5.3 x 6.9, 8.5	5.8 x 7.5, 9.5	5.8 x 7.8, 9.9	5.8 x 7.8, 9.5	5.8 x 7.5, 9.5	5.8 x 7.8, 9.5
83, 10, 8	85, 12, 8	80, 10, 8	85, 12, 8	84, 10, 8	82, 12, 8	86, 12, 8	84, 10, 8	84, 10, 8
Built-in	Built-in	Snap-on	Built-in	Built-in	Snap-on	Built-in	Built-in	Built-in
Chicony/C&T	Philips/ACC	Compaq/Compaq	Compaq/Compaq	Twinhead/ACC	AST/Intel	MTC/ETEQ	SunRex/ACC	SunRex/ACC
Phoenix Q3.0702	Phoenix 1.03	Compaq (2/8/93)	Compaq (5/19/93)	Phoenix 1.1N	AST 2.22.02	Award 3.20-B	AMI (6/21/93)	AMI (6/17/93)
■■	■■	■■	■■	■□	■■	□□	■■	■■
■■	■□	■■	■■	□□	■■	■■	■■	■■
Up to 20MB	4MB–16MB	4MB–16MB	4MB–16MB	4MB–20MB	4MB–32MB	4MB–20MB	4MB–8MB	4MB–20MB
■	■	■	□	■	■	■	■	■
None	None	None	None	None	None	None	None	128K
86MB–213MB	120MB–200MB	120MB–209MB	120MB–209MB	210MB	80MB–200MB	80MB–240MB	130MB–340MB	210MB–340MB
1, 1, 0, 1	1, 1, 1, 1	1, 1, 1, 0	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 0, 1	2, 1, 0, 0	2, 1, 0, 0
□□	■■	■■	■■	□□	■■	□□	■□	■□
□■	□■	■□	■■	□□	■■	□■	□□	□□
None	None	None	None	None	Two Type II or one Type III	Two Type II or one Type III	None	None
2,400-/9,600-bps fax	2,400-/9,600-bps fax	14,400-bps fax	9,600-bps data only	None	None	14,400-bps fax	2,400-/9,600-bps fax	2,400-/9,600-bps fax
Epson/C&T	Toshiba/Cirrus	Compaq/Compaq	Compaq/Compaq	NEC/Cirrus	AST/WD	Sharp/Cirrus	Sharp/C&T	Hitachi/C&T
■	■	■	■	■	■	■	□	■
640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
16	256	16	256	256	256	256	256	256
1,024 x 768	1,024 x 768	800 x 600	800 x 600	1,024 x 768	800 x 600	640 x 480	1,024 x 768	1,024 x 768
256	16	16	16	16	256	16	16	16
■	■	□	■	■	■	■	□	■
1.8 x 6.5 x 3	2.5 x 5.5 x 2.5	1.5 x 5.3 x 3.3	1.5 x 5.3 x 3.3	1.5 x 6 x 2.8	1.8 x 2.8 x 4.5	2.3 x 3.3 x 6.5	2 x 2.8 x 5.8	1.8 x 2.8 x 6
3	2.5	3	4	2	6	2	2	1.5
1:59	1:15	3:01	3:02	2:03	2:47	2:27	2:27	0:51
8, 4	1.3, 1.3	1.5, 1	1.5, 1	8, 2	1.5, 1	2, 2	2, 1	2, 1
1.6 lbs, 1.6Ah	1 lb, 1.7Ah	1.3 lbs, 2.2Ah	1.3 lbs, 2.2Ah	1.5 lbs, 2.3Ah	1.5 lbs, 2.2Ah	1.4 lbs, 2.3Ah	1.2 lbs, 2Ah	1.2 lbs, 2Ah
■■	■□	■■	■■	□■	■■	■■	■■	■■
■■	□■	■□	■□	■□	■■	□□	■□	■□
■□	■■	■■	■■	■□	■■	□□	■□	■□
6.0, 3.1	6.0, 3.1	6.0, 3.1	6.0, 3.1	6.0, 3.1	6.0, 3.1	6.0, 3.1	6.0, none	6.0, 3.1
1 year	1 year	3 years	3 years	1 year	3 years	1 year	1 year	1 year
N/A	N/A	Included	Included	$99	N/A	N/A	N/A	N/A
E8HNB9600C	KOHFT20NT48 DX2UN	CNT75MBZ4E	CNT75MAFAG	FKGSNTFT-486	DJKPWRE286-25SL	FMA6500C	JT5HB3000SO	J75HB3000D2

SUMMARY OF FEATURES

PC MAGAZINE EDITORS' CHOICE

Products listed in alphabetical order ■ = YES □ = NO	IBM ThinkPad 350C	IBM ThinkPad 750C	Logisys Log-486DUA	Logisys Log-486TFT	NEC UltraLite Versa 33C	Panasonic CF-580C	Poly 486-66NC
List price (tested configuration)	$2,499	$4,699	$2,380	$3,519	$5,188	$3,999	$2,888
Processor type and speed	Intel 486SL/25	Intel 486SL/33	Cyrix Cx486SLC/33	Cyrix Cx486SLC/33	Intel 486SL/33	Intel 486SL/25	Intel 486DX2/66
Hard disk capacity	127MB	171MB	209MB	209MB	180MB	120MB	126MB
Dealers/Direct-distribution channel	■■	■■	■■	■■	■□	■□	■■
Dimensions (HWD, in inches)	2.1 x 11.8 x 8.3	2 x 11.8 x 8.3	2 x 11.8 x 8.5	2.3 x 11.8 x 8.5	2.3 x 11.8 x 9	2 x 11.5 x 8.5	2.3 x 11.5 x 9
System weight/Travel weight (pounds)	5.8, 6.4	6.3, 7.8	6.3, 7.7	6.5, 7.9	6.7, 8.4	6.5, 7.7	6.5, 7.9
Display area and diagonal (inches)	5.5 x 7.3, 9	6.5 x 8.5, 10.8	5.8 x 7.5, 9.5	5.3 x 7, 8.8	5.8 x 7.8, 9.5	5.3 x 6.8, 8.5	5.8 x 7.8, 9.5
Keys: total, function, cursor	85, 12, 8	85, 12, 8	84, 12, 8	84, 12, 8	83, 12, 8	84, 12, 8	84, 10, 8
Type of pointing device installed	Built-in	Built-in	Built-in	Built-in	Clip-on	Built-in	Built-in
Motherboard							
Motherboard/chip set manufacturer	IBM/Intel	IBM/Intel	Veridata/Headland	Veridata/Headland	NEC/Intel	MEI/Intel	Microquest/ACC
BIOS version (or date)	IBM (6/23/93)	IBM (7/26/93)	Award 4.2	Award 4.2	Phoenix 5.0	IBM 1.16LIO	AMI (12/12/91)
Setup in ROM/Password in ROM	■■	■■	■□	■□	■■	■■	■□
System shadowing/Video shadowing	■■	■■	■■	■■	□□	■■	■□
Memory and Disk Drives							
Installable RAM	4MB–20MB	4MB–20MB	4MB–20MB	4MB–20MB	4MB–20MB	4MB–20MB	4MB–20MB
User-installable	■	□	■	■	■	■	■
External processor RAM cache	None	None	None	None	None	None	None
Available hard disk sizes	125MB–250MB	170MB–340MB	200MB	200MB	180MB–250MB	200MB	200MB–240MB
I/O and Expansion							
Parallel, serial, mouse, expansion ports	1, 1, 1, 0	1, 1, 1, 1	1, 2, 0, 0	1, 1, 0, 0	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1
High-speed parallel/serial support	■■	■■	□□	□□	■■	■■	■□
Port replicator/Docking station	□□	■■	□□	□□	□■	□■	□■
PCMCIA slots	One Type II	Two Type II or one Type III	None	None	Two Type II or one Type III	One Type II	None
Internal modem installed	None	None	None	9,600-bps fax	None	None	2,400-/9,600-bps fax
Video							
Screen/video chip set manufacturer	Sharp/C&T	DTI/WD	Sharp/C&T	Epson/Cirrus	NEC/C&T	Sharp/WD	Toshiba/C&T
Simultaneous external display	■	■	□	■	■	■	■
Maximum internal resolution	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	800 x 600
Maximum internal colors	256	256	256	256	256	256	256
Maximum external resolution	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
Maximum external colors	256	16	16	16	16	256	256
Active matrix	□	■	□	■	■	■	□
AC Adapter and Battery							
AC adapter size (HWD, in inches)	1.5 x 2.5 x 4.5	1.8 x 2.8 x 5.3	1.8 x 3 x 5.5	1.8 x 3 x 5.8	2 x 3 x 7.3	1.5 x 5.5 x 2.5	1.5 x 5.8 x 2.5
Rated battery life (hours)	4	6	2	2	2	3	1.5
ZDigit battery life (hours:minutes)	2:02	3:38	2:48	2:01	3:52	2:18	1:02
Charge time while on, off (hours)	2.5, 1	2, 1.5	0.5, 0.5	0.5, 0.5	3, 1.5	5, 2	2.5, 1.5
Battery weight, amp/hour rating	1 lb, 2Ah	1.2 lbs, 2Ah	1.1 lbs, 2Ah	1.1 lbs, 2Ah	1.1 lbs, 1.7Ah	0.9 lbs, 1.4Ah	1 lb, 2Ah
Display/hard disk power-down	■■	■■	■■	■□	■■	■■	■■
CPU/peripherals power-down	■□	■□	■□	■□	■■	■■	■□
Standby/Hibernation	■■	■■	■□	□□	■■	■■	■■
Miscellaneous							
DOS, Windows version included	5.02, none	6.1, none	6.0, none	6.0, none	6.0, 3.1	6.0, 3.1	6.0, 3.1
Warranty	1 year	3 years	1 year	1 year	3 years	1 year	1 year
First-year on-site service charge	$40	$40	$100	$100	Included	N/A	N/A
FCC Class B identification number	AN02618C486	AN09545C	HLOXP691C33U	HLOXP691C33T	A3DP50C	ACJ9TG580-25	G3LSKD-4000

N/A—Not applicable: The product does not have this feature.

AMI–American Megatrends Inc., C&T–Chips & Technologies Inc., DTI–Display Technologies Inc., MEI–Matsushita Electric Industrial Co. Ltd., MTC–Mars Technology Corp., WD–Western Digital Corp.

TI TravelMate 4000 WinDX2/40 Color	TI TravelMate 4000E WinDX2/50 Active Color	TI TravelMate 4000E WinSX/25 Color	Toshiba Satellite T1900C	Toshiba T4600C	Wedge ShowBook IV AC	ZDS Z-Note 425Lnc+	ZDS Z-Note 425Lnp+	ZEOS ColorNote 86
$4,398	$5,377	$3,098	$2,500 (estimated)	$5,098	$4,064	$3,899	$3,578	$3,014
Intel 486DX2/40	Intel 486DX2/50	Intel 486SX/25	Intel 486SXA/25	Intel 486SL/33	Intel 486DX2/66	Intel 486SL/25	Intel 486SL/25	Intel 486SX/33
209MB	209MB	127MB	121MB	130MB	127MB	200MB	200MB	125MB
■□	■□	■□	■□	■□	■■	■■	■■	■■
2.3 x 11 x 8.3	2.3 x 11 x 8	2 x 11 x 8.5	2.3 x 11.5 x 8.3	2.3 x 11.8 x 8.3	2.3 x 11 x 8.5	2.3 x 12 x 8.5	2.3 x 12 x 8.5	1.8 x 11.5 x 8.5
6.4, 7.8	6.5, 8	6.2, 7.8	6.8, 8	7.2, 8.4	7.2, 8.7	6.6, 7.9	6.7, 8	5.6, 6.6
6.9 x 7.8, 9.5	5.3 x 6.9, 8.5	5 x 6.8, 8.5	5.8 x 5.5, 9.8	6 x 7.8, 9.5	7.8 x 6, 9.5	5.3 x 7, 8.5	5.8 x 7.5, 9.5	5.8 x 7.8, 9.5
79, 10, 4	83, 12, 8	79, 12, 8	82, 12, 8	82, 12, 8	83, 12, 8	82, 12, 8	82, 12, 8	82, 12, 6
Built-in	Built-in	Snap-on	Snap-on	Snap-on	Built-in	Snap-on	Snap-on	Built-in
TI/TI	TI/TI	TI/TI	Toshiba/Toshiba	Toshiba/Toshiba	Wedge/OPTi	ZDS/ZDS	ZDS/ZDS	ZEOS/ACC
Phoenix 1.01	Phoenix 1.01	Phoenix 1.01	Phoenix (5/19/93)	Toshiba (6/17/93)	Award 3.20K	ZDS (7/21/93)	ZDS (6/16/93)	Phoenix 1.01
■■	■■	■□	■■	■■	■■	■■	■■	■■
■■	■■	■■	■□	■■	■■	□□	□□	■■
8MB–20MB	4MB–20MB	4MB–20MB	4MB–20MB	4MB–20MB	4MB–20MB	4MB–28MB	4MB–28MB	4MB–20MB
□	□	□	□	■	■	■	■	■
None	None	None	None	None	128K	None	None	None
209MB	209MB	120MB	120MB–200MB	120MB–320MB	200MB–340MB	200MB	200MB	85MB–170MB
1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 0	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1	1, 1, 1, 1
■■	□■	□■	□□	■□	□□	■■	■■	■□
■■	■■	■■	□□	□■	■■	■□	■□	□□
None	None	None	One Type I, one Type II, or one Type III	One Type II, one proprietary 16-mm 2.01-compliant	Two Type II or one Type III	None	None	One Type III or one Type II
9,600-bps fax	9,600-bps fax	9,600-bps fax	None	None	None	None	2,400-/9,600-bps fax	14,400-bps fax
Sanyo/Cirrus	Sharp/Cirrus	Sanyo/Cirrus	Info not available/Toshiba	Info not available/WD	NEC/Cirrus	Toshiba/C&T	Toshiba/C&T	Sharp/C&T
■	■	■	□	■	■	■	□	□
640 x 480	640 x 480	800 x 600	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
256	256	256	16	16	256	256	256	16
1,024 x 768	1,024 x 768	1,024 x 768	640 x 480	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
16	16	16	16	16	16	16	16	16
□	■	□	□	■	■	■	□	□
1.7 x 6 x 2.3	1.8 x 6 x 2.3	1.5 x 6 x 2.3	1.3 x 2.8 x 5.8	1.3 x 2.8 x 5.8	2 x 6 x 3.3	1.5 x 5.3 x 2.5	2.8 x 5.5 x 2.5	1.8 x 4.5 x 3
3.5	3.5	3.5	2	2	2.5	2.5	2.5	3
2:51	2:38	3:40	3:25	3:26	3:01	3:39	5:02	1:39
3.5, 3.5	3.5, 3.5	3.5, 3.5	N/A, 1.5	4, 2	6, 2	1.5, 1.5	1.5, 1.5	14, 2
1.3 lbs, 5.7Ah	1.3 lbs, 5.7Ah	1.3 lbs, 5.7Ah	1.2 lbs, 2.4Ah	1.5 lbs, 3Ah	1.7 lbs, 2.8Ah	1.2 lbs, 2.2Ah	1.3 lbs, 2.2Ah	1 lb, 2.2Ah
■■	■■	■■	■■	■■	□□	■■	□■	■■
■□	■□	■■	■□	■□	□□	■■	■■	■□
■■	■□	■■	□■	□■	■■	■■	■■	■□
6.0, 3.1	6.0, 3.1	6.0, 3.1	6.0, 3.1	6.0, 3.1	None, none	6.0, 3.1	6.0, 3.1	6.0, 3.1
1 year	1 year	1 year	1 year	1 year	1 year parts, 3 years labor	1 year	1 year	1 year
$129	$129	$129	N/A	N/A	N/A	$130	$130	N/A
A92486DX2C	A92486DX2C	A92486SXE	CJ6UK191	CJ6UK451	FMA8200C	IFO-486SL25	IFO-486SL25	4FS LK43P

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FACT FILE

Logisys Log-486DUA

List price: $2,380.

Tested configuration: 209MB Toshiba MK-2224FC IDE hard disk with 128K cache, 1.44MB floppy disk drive, 4MB RAM, built-in trackball, DOS 6.0.

Options: 8MB RAM upgrade, $250; trackball, $60; 2-in-1 fax modem and trackball, $220; 9,600-bps fax modem, $150.

Logisys Log-486TFT

List price: $3,519.

Tested configuration: 209MB Toshiba IDE hard disk with 128K cache, 1.44MB floppy disk drive, 4MB RAM, 9,600-bps data/fax modem, built-in trackball, DOS 6.0.

Options: 8MB RAM upgrade, $250; trackball, $60; 2-in-1 9,600-bps fax/modem and trackball, $220; 9,600-bps fax/modem, $150.

In short: Because they are powered by the low-performance, inexpensive Cyrix 486SLC/33 processor, the Logisys portables—both the passive-color Log-DUA and active-color Log-TFT—cost less than many others in this roundup.

Logisys, 4749 East Wesley Dr., Anaheim, CA 92807; 800-333-5679, 714-693-1888; fax, 714-693-1188

454 ON READER SERVICE CARD

comes with an 8.5-inch active-matrix color display and a built-in SCSI port for attaching CD-ROM drives, tape backup drives, scanners, and other peripherals. The Log-TFT shipped to PC Labs for testing also featured a useful module that combines a trackball and an internal fax modem. The module slides into a slot on the left side of the unit and is a $220 option.

The Log-DUA has a rather disappointing dual-scan passive-matrix color display that illuminated some parts of the screen better than others. The system came with a $60 built-in trackball instead of the built-in combination trackball/fax modem. If you already own a portable trackball or care to use a mouse, you will find that the built-in trackball can be removed and replaced with a 9,600-bps data/fax modem. The modem is a $150 option.

Logisys Log-486TFT

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Road warrior	GOOD
Desktop replacement	FAIR

Neither of the systems turned out to be a performance powerhouse on any of our benchmark tests. Though their Cyrix processors helped keep cost down and extend battery life, they were also the slowest chips in the entire test group. On no test did either one of the Logisys machines turn in an above-average score. The units' Winstone marks were particularly lackluster; the Log-DUA posted a score of 6.4, while the Log-TFT turned in a Winstone score of 7.9.

The Log-DUA trailed its active-matrix counterpart on all of our performance tests, except for our DOS video, Graphics WinMark, and battery tests. If there is a bright spot among these two systems' test scores, it would have to be the Log-DUA's battery score of 2 hours 48 minutes. The Log-TFT lasted for 2 hours 1 minute.

Logisys is currently offering the Log-DUA and the Log-TFT with standard one-year warranties on parts and labor. On-site service is available for $100 a year.—*Brad Grimes*

NEC Technologies Inc.

NEC UltraLite Versa 33C

There's a lot to love and hate about the NEC UltraLite Versa 33C active-matrix color notebook. It includes local-bus video, two Type-II PCMCIA slots, a removable hard disk, and a floppy disk that slides out to make room for an additional battery. But it's also expensive ($5,188 for a unit with 8MB of RAM and a 180MB hard disk), and it has a bulky AC adapter that brings its travel weight up to 8.4 pounds. Moreover, it doesn't contain an integrated trackball. The system is also sold by NCR Corp. as the NCR



FACT FILE

NEC UltraLite Versa 33C

NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 800-388-8888, 508-264-8000; fax, 800-327-8329

List price: $5,188.

Tested configuration: 161MB Areal Model OP-220-4003 IDE hard disk with 32K cache, 1.44MB floppy disk, 8MB RAM, Microsoft BallPoint mouse, DOS 6.0, Microsoft Windows 3.1.

Options: 250MB hard disk upgrade, $250; 4MB RAM upgrade, $349; 8MB RAM upgrade, $699; docking station, $699; 14,400-bps PCMCIA fax modem, $699; PCMCIA 10BaseT Ethernet card, $349; battery charger, $199; 12-volt battery adapter, $69; 5MB PCMCIA mass storage card, $699.

In short: The NEC UltraLite Versa 33C is great as an upgradable machine, and local-bus video makes it really perform. But high price and an oversize adapter are two strikes against it.

455 ON READER SERVICE CARD

Safari 3180 portable.

Along with the Versa 33C's superb performance, you get the abilities to change screens. The display progression runs from a passive monochrome through active-matrix color and pen-based computing.

The unit's 486SL/33 processor performed in line with the other 486DX/33 processors in this roundup and it was just a step behind the higher-powered chips. The Versa 33C's local-bus video reaped top-level scores on our DOS video, Graphics WinMark, and Winstone tests. The Versa 33C uses one of the largest nickel hydride batteries available. With a single battery installed, the Versa 33C showed an excellent battery life of 3 hours 52 minutes. Add the second battery and you're ready for a coast-to-coast flight.

NEC UltraLite Versa 33C

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Road warrior	GOOD
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

The Versa 33C's keyboard is well laid out, and each key has a good travel distance, providing a responsive feel. The display tilts back 180 degrees so that it can be used with an external display, but the slide brightness adjustment didn't have much of an effect on the display's image. Like all Versa notebooks, the Versa 33C comes with a three-year warranty. With NEC's UltraCare Warranty Service Program, you can have your system repaired within one business day.—*BG*

Panasonic Communications & Systems Co.

Panasonic CF-580C

The $3,999 Panasonic CF-580C active-matrix notebook is a mixed bag. It is a well-designed product with side-mounted plugs, a Type-II PCMCIA slot, and a roomy, responsive keyboard. But it has one of the worst built-in trackballs around—tiny, *un*responsive, and poorly laid out above the keyboard. If you decide on this machine, you'll probably want to use an external trackball.

Panasonic CF-580C

SUITABILITY TO TASK	
DOS applications	GOOD
Windows application	GOOD
Road warrior	GOOD
Desktop replacement	GOOD

Adding something like the new Microsoft BallPoint Mouse would be a good idea, since the performance you get out of this 25-MHz 486SL notebook would be worth the cost of a clip-on mouse. Its DOS video score was in our roundup's top five, outpacing several better-equipped systems.

Windows-based performance was average, but the notebook made up ground with a Winstone score that ranked 14th—despite the fact that the unit has one of the least-capable CPUs here. Battery life was about average at 2 hours 18 minutes.

With one of the smallest and lightest power adapters available, the CF-580C has an excellent 7.7-pound travel weight. At a height of 2 inches, it is also one of the thinnest notebooks available today. If you want to leave the PCMCIA slot open for a LAN adapter or memory card, you can install a modem in the unit's internal modem slot. For hard disk space beyond the 120MB base capacity, the CF-580C comes with SuperStor disk compression software.

The CF-580C comes with a one-year warranty on parts and labor, and if you ship the notebook to Panasonic for repair, they'll pay the shipping both ways and send it back to you within 24 hours—a real bonus for the traveler.—*BG*



FACT FILE

Panasonic CF-580C

Panasonic Communications & Systems Co., Two Panasonic Way, Secaucus, NJ 07094; 800-742-8086, 201-348-7000; fax, 817-685-1210

List price: $3,999.

Tested configuration: 120MB Seagate ST9235A IDE hard disk, 1.44MB floppy disk, 4MB RAM, DOS 6.0, Microsoft Windows 3.1.

Options: 4MB RAM card, $479; 16MB RAM card, $3,699; docking station, $599; 14,400-bps data/fax modem, $439; rechargeable battery, $179; AC adapter, $129.

In short: A solid all-around color system that offers great midrange battery life, the Panasonic CF-580C disappoints with a hard-to-use integrated trackball. If you decide on this machine, you'll probably want to use an external trackball; the performance you'll get will be worth the cost of a clip-on mouse.

456 ON READER SERVICE CARD

Texas Instruments Inc.

TI TravelMate 4000 WinDX2/40 Color

TI TravelMate 4000E WinDX2/50 Active Color

TI TravelMate 4000E WinSX/25 Color

When we last reviewed notebook PCs in August, Texas Instruments' TravelMate 4000 line won an Editors' Choice award. The newly introduced TI TravelMate 4000E WinDX2/50 Active Color sets a new standard of power and performance in a notebook design. The $4,499 price tag for a unit with 4MB of RAM and a 209MB hard disk is certainly high, but the product is, after all, an active-matrix 486DX2/-50-based portable that could effectively double as a desktop PC. The only drawback is the lack of PCMCIA support.

TI TravelMate 4000 WinDX2/40 Color

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Road warrior	GOOD
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

The WinDX2/50—like its two passive-color cousins, the TI TravelMate 4000 WinDX2/40 Color and the TI TravelMate 4000E WinSX/25 Color—is a study in intelligent design. All expansion ports are located on the left side of the notebook so you can easily attach peripherals. The keyboard is nicely laid out, although it's a bit mushy. The AC adapter is light and compact, thereby keeping the machine's travel weight under 8 pounds. A QuickPort adapter accommodates a cordless version of the new Microsoft BallPoint Mouse.

The WinDX2/50 also performs like a champ. Its DOSmark and processor scores were the best here, outdistancing those of all the 486DX2/66-based models. Its Disk WinMark, Graphics WinMark, and Winstone scores were in the top five. When you consider what the WinDX2/50 is packing—a clock-doubled processor and an active-matrix display—its battery life of 2 hours 38 minutes is a pleasant surprise.

TI TravelMate 4000E WinDX2/50 Active Color

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Road warrior	GOOD
Desktop replacement	EXCELLENT
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

Both the WinSX/25 and the WinDX2/40 employ passive-matrix displays and provide more-than-adequate visibility. Both units delivered great performance when compared with systems in their respective processor classes, and the WinSX/25 even beat out more powerful processors in some cases. On the other hand, the WinDX2/40 struggled on our DOS video tests, earning the lowest score here, but it made up ground elsewhere, doing well on our Disk WinMark and Graphics WinMark tests and excelling on our processor and disk tests. The WinSX/25 and the WinDX2/40 posted average Winstone scores of 9.9 and 13.3, and battery scores of 3 hours 40 minutes and 2 hours 51 minutes, respectively. Ready for the road, they each weigh 7.8 pounds.

TI TravelMate 4000E WinSX/25 Color

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Road warrior	GOOD
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

Texas Instruments, like Compaq Computer Corp. and other notebook vendors, has stayed away from implementing PCMCIA technology in its notebooks. Instead, all three models here will accept proprietary internal devices. In addition to the built-in ports, there is an optional I/O port expander that attaches to the



FACT FILE

TI TravelMate 4000 WinDX2/40 Color

List price: $4,398.

Tested configuration: 209MB Seagate ST9235AG IDE hard disk with 64K buffer, 1.44MB floppy disk, 8MB RAM, 9,600-bps data/fax modem, Microsoft BallPoint mouse, DOS 6.0, Microsoft Windows 3.1.

Options: 4MB RAM upgrade, $279; 16MB RAM upgrade, $1,999; expansion station, $929; port replicator, $199; extra battery, $89; 9,600-bps data/fax modem, 599; Ethernet adapter, $469; numeric keypad, $79; SCSI adapter, $369.

TI TravelMate 4000E WinDX2/50 Active Color

List price: $5,377.

Tested configuration: 209MB Seagate ST9235AG IDE hard disk with 64K buffer, 1.44MB floppy disk, 8MB RAM, 9,600-bps data/fax modem, Microsoft BallPoint mouse, DOS 6.0, Microsoft Windows 3.1.

Options: Same as for the WinDX2/40.

TI TravelMate 4000E WinSX/25 Color

List price: $3,098.

Tested configuration: 127MB Seagate ST9144A IDE hard disk with 64K buffer, 1.44MB floppy disk, 4MB RAM, 9,600-bps data/fax modem, Microsoft BallPoint mouse, DOS 6.0, Microsoft Windows 3.1.

Options: Same as for the WinDX2/40.

In short: The TravelMate 4000 family is still top of the line, and the WinDX2/50 Active Color sets new standards of performance. PCMCIA support would make it a royal family.

Texas Instruments Inc., P.O. Box 202230, Austin, TX 78720-2230; 800-527-3500, 817-771-5856; fax, 817-774-6660

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back of each unit and gives you additional serial, parallel, and game ports.

Texas Instruments offers these units with one-year warranties on parts and labor. On-site service is available through NCR Corp. for $129 a year.—*BG*

Toshiba America Information Systems Inc.

Toshiba Satellite T1900C

If you're excited about PCMCIA technology and are looking for an inexpensive machine that doesn't need to be a stellar performer, look no further. Among the machines we tested, the 20-MHz Toshiba Satellite T1900C—with an estimated street price of $2,500—offers a cost-effective opportunity to jump on the PCMCIA/color bandwagon.

Its dual-scan passive-matrix screen is bright and sharp, especially when compared with the other passive-matrix screens we saw. The third entry in Toshiba's low-end Satellite line, the T1900C weighs 8 pounds, including the AC adapter and power cord. But lefties beware: The snap-on mouse can only be used on the right side. The PCMCIA slot can accommodate either two Type-II cards or one Type-III card.

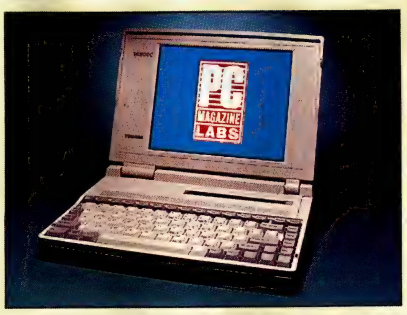
Toshiba Satellite T1900C

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Road warrior	EXCELLENT
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

The 486SXA/20-powered T1900C performed poorly on almost all of our tests, though it should be noted that its 20-MHz processor is slower than the chips in most of the other systems tested. Taking that as a given, the trade-off is between performance and battery time. The T1900C's DOSmark, Graphics WinMark, Disk WinMark, and processor scores landed in the bottom third, but its battery time was an impressive 3 hours 25 minutes.

Toshiba's $4,699 T4600C, a faster and heavier but otherwise similar (in terms of features) model with an active-matrix screen, did not perform well on our tests either. Its DOSmark, Graphics WinMark, Disk WinMark, and processor scores were average. Its Winstone score, however, was poor, landing in the lower third. Along with a price tag that's twice the size of the T1900C's, the system comes with a better screen and larger potential hard disk capacity but a higher travel weight.

The T1900C comes with a one-year warranty, and Toshiba does not offer on-site service.—*Elisabeth Holzer*



FACT FILE

Toshiba Satellite T1900C

Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445, 714-583-3000

Estimated street price: $2,500.

Tested configuration: 121MB Toshiba MK-2124FC IDE hard disk with 8K cache, 1.44MB floppy disk, 4MB RAM, snap-on trackball, DOS 6.0, Microsoft Windows 3.1, UltraFont software.

Options: 4MB RAM upgrade, $399; 8MB RAM upgrade, $679; 16MB RAM upgrade, $2,549; external 5.25-inch floppy disk, $359; extra nickel hydride battery, $139; PCMCIA 14,400-bps data/fax modem, $499; battery charger, $175; car adapter, $125; AC adapter, $89; security lock, $55.

In short: The Toshiba Satellite T1900C's PCMCIA slots and sharp screen are its best selling points, especially within its price range. But for many users, its poor performance may outweigh its attributes.

459 ON READER SERVICE CARD

Toshiba America Information Systems Inc.

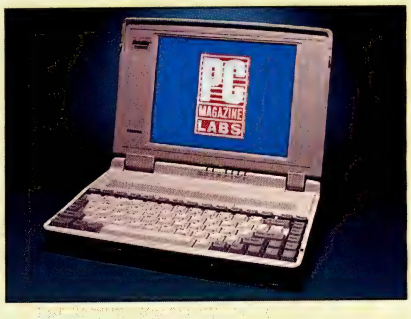
Toshiba T4600C

The latest addition to the T4000 line of Toshiba notebooks, the Toshiba T4600C, weighs in at 8.4 pounds and costs $4,699. It includes an extra-large PCMCIA slot that can accommodate a modem with attached phone plugs. Except for its bigger screen and slightly modified case layout, it's a twin to the Toshiba T4500C.

Toshiba T4600C

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Road warrior	EXCELLENT
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	BELOW AVERAGE

The active-matrix screen produces images that are clear and crisp, and the large 9.5-inch display is a nice improvement over the T4500C's display. The T4600C is also available as a monochrome unit. The hard disk is expandable to 320MB (on color models only), and RAM is expandable to 20MB.



FACT FILE

Toshiba T4600C

Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine CA 92718; 800-334-3445, 714-583-3000

List price: $4,699.

Tested configuration: 130MB Toshiba MK-2124FC IDE hard disk with 32K cache, 1.44MB floppy disk, 4MB RAM, snap-on trackball, DOS 6.0, Microsoft Windows 3.1.

Options: 4MB RAM upgrade, $399; 8MB RAM upgrade, $679; 16MB RAM upgrade, $2,549; docking station, $849; extra nickel hydride battery, $229; PCMCIA 9,600-/14,400-bps data/fax modem, $499; battery charger, $279; AC adapter, $89; car adapter, $149; SCSI adapter, $245; security lock, $55.

In short: This is a solid notebook with decent expansion and a great display, but it lacks top-notch performance and is a little on the heavy side.

459 ON READER SERVICE CARD

The T4600C offers two types of PCMCIA slots: a regular Type-II slot and a proprietary 16-mm slot. Toshiba has released the specifications for its 16-mm slot to third-party vendors. Toshiba also offers docking stations and SCSI adapters as options for extra expandability.

The T4600C showed decent but no better than average performance. Its lack of local-bus video showed; the unit posted below-average to average scores on our DOS video and Graphics WinMark tests and a below-average score on our Winstone test. It performed solidly on our processor and disk tests, however. The unit's fine 3 hour 26 minute battery life comes at the expense of size and weight; by today's standards, this is considered to be a heavy system that feels large compared to more recent designs.

If you don't require a full-featured notebook, you might want to consider the less expensive passive-matrix Toshiba Satellite T1900C. It costs $2,000 less than the T4600C and offers only slightly less performance and a full hour more of battery life.

Toshiba offers a one-year parts-and-labor warranty, and the company's Exceptional Care repair plan is also thrown in at no additional cost. —*Anush Yegyazarian*

Wedge Technology Inc.

Wedge ShowBook IV AC

The $4,064 Wedge ShowBook IV AC is basically a good machine, offering 3-hour battery life, better-than-average performance, and excellent expansion options. On the downside, the ShowBook is one of the heaviest notebooks we tested.

Expansion features abound, with memory expandable to 20MB and the hard disk expandable to 340MB. There's also a PCMCIA Type-III slot (which can also double as two PCMCIA Type II slots), a docking station with VESA local-bus slots, a SCSI port. The active-matrix screen can be downgraded to a dual-scan passive-matrix or monochrome screen. If your computing needs don't require a 486DX2/66 CPU, the ShowBook is also available with an SX/25, an SX/33, a DX/33, or a DX2/50 processor. The system's travel weight is a hefty 8.7 pounds.

The unit's overall performance on our tests was very good. The ShowBook ranked in the top five in all test categories except for DOS disk, where it was average. The ShowBook's standard local-bus video came through to secure the top Graphics WinMark score of 4.6 million pixels per second and an above-average Winstone score of 29.1. On our Battery Rundown tests, the ShowBook lasted 3 hours 1 minute between charges.

The ShowBook's case is well designed, with a rounded wrist rest in front of the keyboard and no sharp corners. One problem worth mentioning is the awkward placement of the built-in trackball at the top right-hand corner below the screen.

Instead of using an LCD panel, the ShowBook uses clearly labeled LEDs. It does not, however, have a handy counter for available battery power.

The ShowBook comes with a one-year parts, three-year labor warranty. On-site service is not available.—*AY*



FACT FILE

Wedge ShowBook IV AC

Wedge Technology Inc., 1657 McCandless Dr., Milpitas, CA 95035; 800-872-9334, 408-263-9888; fax, 408-263-9886

List price: $4,064.

Tested configuration: 127MB Seagate ST9144A IDE hard disk with 64K cache, 1.44MB floppy disk, 8MB RAM with 128K of external cache, DOS 6.0, Microsoft Windows 3.1.

Options: 340MB hard disk upgrade, $350; 4MB RAM upgrade, $260; 8MB RAM upgrade, $520; 12MB RAM upgrade, $780; PCMCIA 4,800-/9,600-bps data/fax modem, $235; Ethernet with 10Base2 and 10BaseT, $175.

In short: This is a serviceable notebook with great performance at a price worth considering.

460 ON READER SERVICE CARD

Wedge ShowBook IV AC

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Road warrior	GOOD
Desktop replacement	EXCELLENT



CIRCLE 150 ON READER SERVICE CARD

Zenith Data Systems

ZDS Z-Note 425Lnc+
ZDS Z-Note 425Lnp+

Zenith Data Systems has two competitive offerings in this roundup: the active-matrix ZDS Z-Note 425Lnc+ ($3,899) and its near twin, the dual-scan passive-matrix ZDS Z-Note 425Lnp+ ($3,578). Both offer decent performance and are worth a look—especially by those interested in network readiness.

The most distinguishing feature is the Ethernet-compatible LAN port and the client "shells" that come preloaded on each system to facilitate network hookups. Additionally, the two systems both have good expansion options; ZDS's port replicator is available on each for $79, and RAM is expandable to 28MB on the motherboard. Each unit comes with all the standard ports, as well as a dedicated expansion port and modem port. The hard disk comes in only one size (200MB), but that should be enough for most users.

ZDS Z-Note 425Lnc+

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Road warrior	EXCELLENT
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	BELOW AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

In terms of performance, the Z-Notes were good all-around systems. The two units paralleled each other on all tests, achieving mostly average results. The exceptions were in DOS video, where they excelled, and disk performance, where they fared particularly poorly; their disk scores were consistently the lowest of the entire group. Predictably, battery performance differed between the two systems, with the Lnp+ lasting an excellent 5 hours 2 minutes and the Lnc+ lasting a very strong 3 hours 39 minutes.

The units weigh in at about 8 pounds apiece and are equipped with one of the smallest, lightest power adapters in this roundup. The NotePoint, ZDS's snap-on trackball, attaches to the unit below the Spacebar at the front of each unit and has a rounded, sloped face. The putty-colored case has a keyboard that is fairly comfortable to use.

ZDS Z-Note 425Lnp+

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Road warrior	EXCELLENT
Desktop replacement	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	BELOW AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

Both screens offer good color, though the dual-scan system had the same kinds of problems with fading when viewed from the side that all passive-matrix systems have.

For personal work, the Lnp+'s battery life and price have the advantage, but for presentations, the edge goes to the Lnc+. Its active color is clear and bright. It has only an 8.4-inch viewable screen, however, which compares with its twin's 9.5-inch screen. ZDS is currently phasing out the 8.4-inch active screen in favor of a 9.5-inch display.

All ZDS notebooks have one-year parts-and-labor warranties.—*AY*



FACT FILE

Z-Note 425Lnc+

List price: $3,899.

Tested configuration: 200MB Seagate ST-2210 hard disk with 8K cache, 1.44MB floppy disk, 4MB RAM, DOS 6.0, NotePoint trackball, Microsoft Windows 3.1.

Options: 4MB RAM upgrade, $279; port replicator, $79; port replicator with Token-Ring, $499; extra battery, $149; 14.4 send/receive fax modem, $499; car adapter, $129; security lock, $59.

Z-Note 425Lnp+

List price: $3,578.

Tested configuration: 200MB Seagate ST-2210 hard disk with 8K cache, 1.44MB floppy disk, 4MB RAM, 2,400-9,600-bps data/fax modem, NotePoint trackball, DOS 6.0, Microsoft Windows 3.1.

Options: Same as for the 425Lnc+.

In short: These are solid machines with decent performance, network readiness, and competitive prices.

Zenith Data Systems, 2150 E. Lake Cook Rd., Buffalo Grove, IL 60089; 800-553-0331, 708-808-5000; fax, 800-808-4434

461 ON READER SERVICE CARD

ZEOS International Ltd.

ZEOS ColorNote 486

The ColorNote 486 from ZEOS International is the only unit in this roundup to use the Intel 486SX/33 chip.



FACT FILE

ZEOS ColorNote 486

ZEOS International Ltd., 1301 Industrial Blvd., Minneapolis, MN 55413; 800-554-7172, 612-633-4591; fax, 612-633-1325

List price: $3,014.

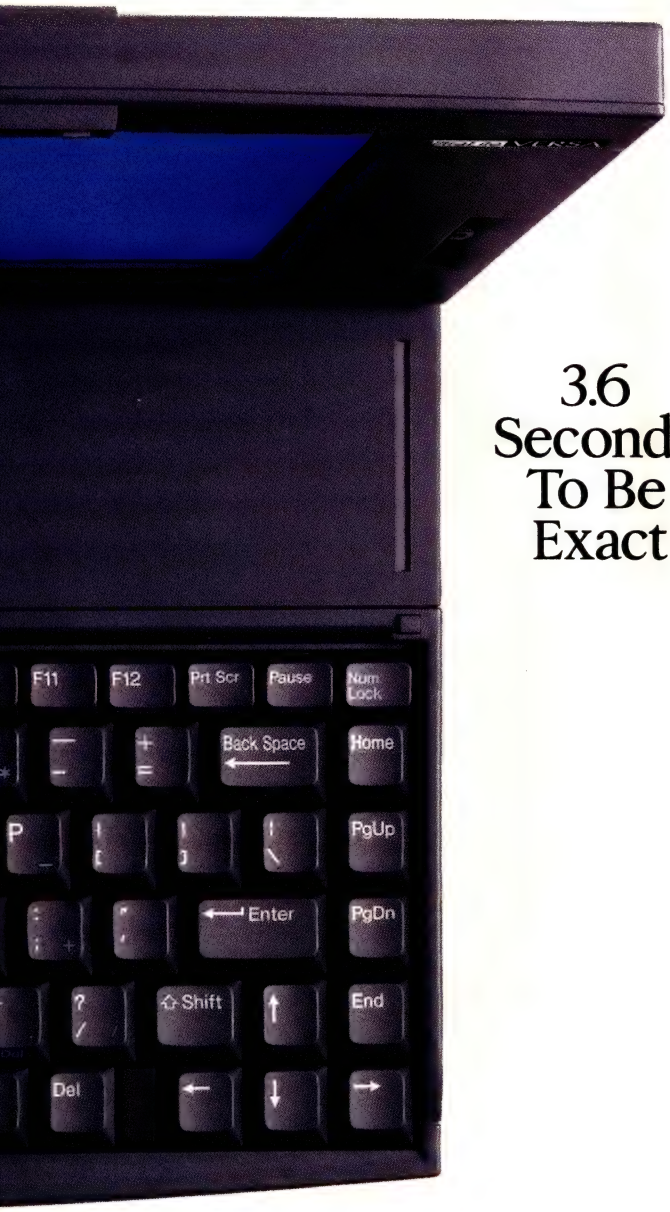
Tested configuration: 125MB Toshiba MK 1522 FCV IDE hard disk with 128K cache, 1.44MB floppy disk, 4MB RAM, 14,400-bps fax modem, DOS 6.0, Lotus Organizer 1.1, Microsoft Windows 3.1.

Options: 170MB hard disk upgrade, $150; 4MB RAM upgrade, $198; 16MB RAM upgrade, $1,495; extra nickel hydride battery, $99; PCMCIA 14,000-bps modem, $379; PCMCIA Ethernet adapter, $229; external keyboard, $50; external numeric keypad, $79; extra AC adapter, $69; external charging stand, $79; DC adapter, $49.

In short: The only 486SX/33-based system here, the ZEOS ColorNote 486 produced midrange test results. It is hindered by case-design problems, a poor display, and short battery life.

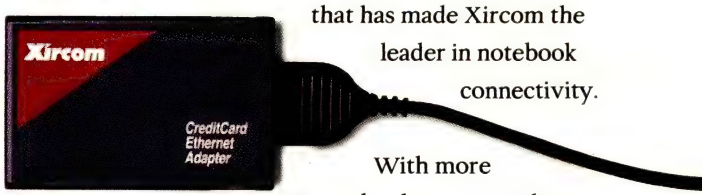
462 ON READER SERVICE CARD

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CIRCLE 211 ON READER SERVICE CARD

List-priced at $3,014, it is cheaper than most of the DX/33-based systems reviewed here, but its poorly designed case and low battery life keep it from being a better notebook value.

Like the screen of the reviewed AST Bravo NB 4/25s ColorPlus, the ColorNote's screen will not stay at a tilted angle without falling backwards—an annoying and frustrating aspect of its design. Another major design drawback is the trackball's small ball and the awkward placement of the actuation buttons.

One good thing about the case is its light 6.6-pound travel weight; only the IBM ThinkPad 500 weighs less. As for thickness, the ZEOS proves less is more with a 1.8-inch depth—the thinnest of those tested.

ZEOS ColorNote 486

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Road warrior	EXCELLENT
Desktop replacement	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

The ColorNote uses a Sharp dual-scan passive-matrix display that produces clear and bright images. The system came to us with a 125MB hard disk. The unit has a single Type-III PCMCIA slot that doubles as a Type II and comes with a 14,400-bps data/fax PCMCIA fax modem.

Although the ColorNote uses a nickel hydride battery, it managed a battery score of only 1 hour 39 minutes, which ranked near the bottom of the tested systems. This is probably an outcome of using a smaller cell than most of the contenders in this review. Although the unit has built-in local-bus video, its DOS video and Graphics WinMark scores were just about average. All other scores were solidly in the middle of the pack.

Although the ColorNote is light and reasonably priced, there are just a few too many "gotchas" to make it a worthy choice. The unit comes with a standard one-year warranty; ZEOS does not offer on-site service with this system. —*Stephen W. Plain*

Illustration by David Kahl

PCMCIA: AN INSIDE LOOK



Power And Potential

The hype surrounding PCMCIA technology probably has you on an information roller coaster. *PC Magazine* tests 32 credit card–size peripherals to clear up the confusion.

By Oliver Rist

For the last two years, PCMCIA has generated billowing clouds of hype from PC-industry visionaries. Unfortunately, much of this hype amounts to only so much vaporware and wishful thinking. Being skeptics, we decided to find out exactly where the PCMCIA specification stands and who is driving it.

Happily, we've discovered that while the visionaries are dreaming, the pragmatists are pushing PCMCIA card technology forward. Granted, solutions are becoming available a little more slowly than many would like, but they *are* becoming available. And their effects are that much more exciting precisely because they are tangible.

When the Personal Computer Memory Card International Association

(PCMCIA) was established in June 1989, its mission was to establish a standard for making and marketing credit card–size memory modules, officially known as PC Cards. One year later, the PCMCIA specification Release 1.0 was adopted, and it designated standards for incorporating various memory technologies onto Type I PCMCIA cards. Sockets for these cards were 3.3-mm high and carried a 68-pin pinout. The footprint is 54 by 85.6 mm.

In September 1991, the specification was revised to include standards for I/O cards—modems, LAN cards, mass storage, and other peripherals. This became Release 2.0 and included a specification for 5-mm Type II–size cards. The latest specification is Release 2.01 (some bug fixes were necessary to Release 2.0), which includes support for the even larger 10.5-mm Type III card, used mainly for miniature hard disks.

Even before Release 2.0 was officially adopted, its intent electrified the industry. It was basically a modern, open, miniature-bus architecture. By the time the standard was adopted in 1991, PCMCIA had already made agreements with the Japan Electronic Industry Development Association (JEIDA); indeed, the Version 2.0 specification was simultaneously accepted as the JEIDA 4.1 spec. These talks ensured that PCMCIA would become a global standard.

EDITORS' CHOICE

- **Maxtor MXL-105-III hard disk**
- **SunDisk SDP Flash Card**

Because PCMCIA technology is still evolving, we almost decided not to make any Editors' Choice selections at this time. However, since the PCMCIA card specification is presently stable and the only thing lacking is how vendors will implement it, we thought it fitting to recognize a couple of quality mass-storage products.

We didn't, however, make an Editors' Choice selection in the modem category because few of these products actually use the PCMCIA-specified Card and Socket Services—most use proprietary enabler drivers that contain bits and pieces of their own versions of these software modules. These drivers may allow the card to function, but they inhibit compatibility between cards and make hot swapping impossible.

On the solid-state memory card scene, we chose the SunDisk SDP Flash Card. Although flash memory cards are fast becoming the most popular, SunDisk Corp.'s entry was the only flash card that actually worked with our test systems and it was the only memory card to use the ATA interface standard recognized by PCMCIA. If more vendors

THE ADVANTAGES, THE HYPE

Some of you may not have heard the hype yet, so we'll present it here in condensed form. Be aware that not all of this is vaporware; it's only considered hype because most of the products carried a delivery date marked "today," yet they still haven't arrived.

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PCMCIA's proponents point to four key advantages of the PCMCIA architecture:

•*Host independence* allows PCMCIA cards to be run with any computer carrying a PCMCIA-compliant interface. According to the visionaries, it is possible for the same PCMCIA card to be run on an IBM-compatible PC, an Apple Newton, or an AT&T Personal Communicator, providing they've all got a PCMCIA socket.

•*Easy installation and configuration* (called "plug-and-play" by PCMCIA vendors) is probably the most hyped advantage of PCMCIA cards. Just pop a PCMCIA card into its slot, turn on your system, and the card automatically configures itself.

•*Hot swapping* refers to the ability to pull one PC Card out of your system, insert another, and keep on computing—no reboot is required.

•*Execution in place (XIP)* means that once software is loaded into ROM on a PCMCIA card, it can be run directly from the card without first being loaded into the host system's RAM. This feature would be especially useful in subnotebooks and palmtops where systems lack internal floppy drives and are limited in their amount of internal memory.

You can see where all the excitement stems from: fully featured peripheral cards built to a universal electronic standard where operation requires no configuration. They really could change the face of modern computing. Imagine never having to deal with case screws, jumpers, or DIP switches. This isn't just a boon to those of us who hate screwdrivers. It will also help get the still-intimidated portion of our population into computing, and it provides obvious benefits to disabled users.

The association is even trying to get large software vendors to modify popular applications so that they become PCMCIA-card aware. When that happens, not only won't you have to reconfigure your machine when you pop in a modem (no more IRQ confusion!), but you also won't have to configure your communications package. Just insert, dial, and download.

Execution in place has potential as well. Combine this technology with high-capacity solid-state memory cards, and all of a sudden you can carry your computing environment in your shirt pocket. Not just your applications, but your applications *configured your way.* Plug these into any PCMCIA-compatible host, and you can work anywhere.

THE REALITY

That's the hype. The visionaries are singing its praises, and the pragmatists are

would use this standard, the goal of universal PCMCIA-card compatibility would be much closer. Since flash memory is slightly slower than more expensive SRAM, the 5MB SunDisk card lagged slightly in performance—but not by much—and it offers lower cost, lower power consumption, and higher capacity in return. (Though we only tested a 5MB card, SunDisk now makes Type II flash cards with up to 40MB of storage).

The Maxtor MXL-105-III, a 105MB PCMCIA hard disk, was a marvel. While both Integral Peripherals and the MiniStor Peripherals Corp. needed Toshiba's bigger proprietary "Type IV" slot size to implement only 85MB, Maxtor Corp. managed to squeeze 105MB into a card that will work in any notebook equipped with a standard Type III PCMCIA slot.

methodically plodding along behind trying to make it a reality. Right now, that reality is a way off.

The key is compatibility, and that hinges on software, which has not yet caught up with the technology's hardware. Every day, manufacturers are crawling out of the woodwork with new PCMCIA products, but not all of them implement the PCMCIA specification in the same way.

The PCMCIA-defined driver specifications are called Card and Socket Services in Release 2.0. These software elements were designed to configure seamlessly and to initialize any PCMCIA card. Unfortunately, manufacturers of both PCMCIA card software and hardware were able to interpret these guidelines differently, because the original specification wasn't specific enough.

EARLY ADOPTERS

Manufacturers, however, barreled ahead anyway and ended up with a slew of incompatible products—not just PCMCIA cards, but PCMCIA drivers and host adapters. Such widespread incompatibility has stalled the benefit of host independence. Notebook makers can only include one PCMCIA host adapter chip on a motherboard, and right now these chips simply can't address all cards or all drivers. Such flexibility is not mandatory in the PCMCIA specification, so not all vendors have implemented it. The goal is software that can handle multiple platforms.

The same problem has hampered plug-and-play. Right now, most PCMCIA peripherals come with a driver disk that requires the same I/O information that any peripheral needs. Although the new versions of universal PCMCIA drivers being developed by SystemSoft Corp. and Phoenix Technologies have elements that handle configuration and system resource-allocation duties, none of these drivers actually talk to the system. All merely assume that their resource allocations are correct. If you've got something connected to the serial port on your laptop and you plug in a PCMCIA card that also wants to use the same port, then *you* must tell the PCMCIA software. It won't be able to tell by itself, and that has crippled the realization of PCMCIA plug-and-play.

Of all the promises PCMCIA has made, hot swapping will perhaps be the most difficult to keep. To make it work, each vendor needs to implement the PCMCIA software layers the same way, and that just isn't happening. Today, there are two major Card and Socket Services makers: Phoenix Technologies, whose drivers ship with Phoenix's system BIOS and IBM's PC-DOS; and SystemSoft Corp., whose drivers ship with SystemSoft's system BIOS product. As of this fall, the SystemSoft drivers have been included in all of Microsoft's operating systems. But there are a bunch of other players out there as well, such as Ventura Micro Inc., and all are trying to get to the same place via different routes.

Instead of addressing all these different driver manufacturers, many card makers have decided to take matters into their own hands. They ship special PCMCIA client drivers called enablers. These drivers have their own versions of Card and Socket Services built-in, and thus can talk to the host adapter directly. This allows them to be configured quickly, but the situation can get hairy when you try to plug another PCMCIA card into your second slot and use either the original PCMCIA services or another enabler. If this is your problem, you'll probably end up with only one PCMCIA card in your notebook at a time, and you'll have to reboot the machine every time you want to install another one. So much for hot swapping.

Though the reality of PCMCIA technology may be a bit disappointing after hearing about the potential benefits, you can still get close to this computing utopia. You've just got to be careful.

As an interim fix, makers of both PCMCIA cards and notebooks are publishing lists of compatible products. The systems are sticking to a specific host adapter chip and one type of PCMCIA Card and Socket Services implementation, while the card makers promise to be compatible with it. If you're considering buying into PCMCIA now, you should *never* purchase a product, notebook, or card unless the vendor is willing and able to provide you with such a list.

THE NEXT STEPS

What changes might you see soon? For one thing, the PCMCIA is battling hard to design specifications for a 32-bit bus. The problem here is that the original PCMCIA specification wasn't designed for that kind of throughput, especially on the hardware side. Many engineers doubt that 68 pins will be enough to handle the necessary bandwidth.

That's why members of the association are considering a new pin designation. At press time, talks hadn't progressed very far. Some say it can be done with the original 68 pins, others want 88 pins, and a few are looking for 120 pins. Whatever happens, PCMCIA says it guarantees that any new socket size or spec version will be fully compatible with old products.

PCMCIA is also taking power consumption into consideration. Right now, PCMCIA peripherals run at either 5 or 12 volts. These peripherals can dry up notebook batteries 25 percent faster than normal usage does, or even faster. The rate of battery usage depends on the amount of time the cards are actually in use. With notebook vendors moving to 3.3-volt technology, PCMCIA is forced to keep pace and has created a committee to address 3.3/5 volt operation..

What you *won't* see is an official new

slot height. PCMCIA feels it has addressed all possible uses with the Type I, II, and III slot sizes. It is strongly against a new and 16mm slot.

That hasn't stopped Toshiba, however. The company introduced its notorious 16mm slot when it shipped its T4500 notebook. Unfortunately for PCMCIA, Toshiba is a major trendsetter in the notebook arena, and many hard disk and modem makers have designed or plan to create cards for this slot size in order to take advantage of Toshiba's vast market share. The taller size allows hard disk vendors more capacity, but it was actually designed to let modem makers build RJ-11 plugs into the notebook instead of attaching them to an annoying (and easily lost) dongle. The popularity of this slot size is catching on, and it may end up becoming a de facto standard, despite what PCMCIA might think.

WHAT CAN I GET TODAY?

So assuming you can get it to work, what kind of peripheral bliss can PCMCIA offer you today? To figure this out, you'll have to do some careful research, because the answer changes daily. The association has been announcing either a new product or some positive change to the specification almost weekly. Your best bet is to call your notebook vendor and ask about the latest scoop.

Modems are one of the most popular applications for PC Cards, and many notebook makers have eliminated the internal modem in favor of a PCMCIA slot.

At *PC Magazine,* we asked for as many cards as we could get. The results were disappointingly slim. We grabbed at everything except LAN cards, which we left to our networking team (see "Compact Connections" in this issue), and managed to garner 32 cards plus one special case (reviewed in a sidebar) and one late straggler. We ran benchmark tests at ZD Labs using an AST PowerExec 4/25SL ColorPlus, an IBM ThinkPad 720C, an NEC UltraLite Versa 25C, and a Toshiba T4600C notebook. We checked all four machines for compatibility but reserved the Toshiba T4600C for our test-bed.

MODEMS

Modems are one of the most popular applications for PC Cards. In fact, many notebook makers have eliminated the internal modem in favor of a PCMCIA slot. PCMCIA modems make up around 73 percent of the portable data modem market according to International Data Corp. (IDC). We received 13 modems from manufacturers that included AT&T Paradyne, Hayes, Intel, Megahertz Corp., Practical Peripherals, and TDK Corp. AMT was unable to ship its 14,400-bps modem in time, though we have seen the company's $220 2,400-/9,600-bps data/fax

GPS on a Notebook

by Brian Nadel

During Operation Desert Storm, tank commanders had a high-tech weapon that worked flawlessly: the Defense Department's Global Positioning Satellite (GPS) network. This system calculated position to within 10 feet, allowing precise targeting. More recently, a GPS receiver helped to pilot a jet precisely along the Potomac River. Now you can tap into this 24-satellite network, which resides 11,000 miles above earth, with the Mobile GPS from Socket Communications (800-552-3300).

The only difference between Socket's $795 PCMCIA unit and more expensive military and scientific receivers is that it is slightly less accurate. Instead of locating a position to within 10 feet, the civilian GPS system can plot a position within about 80 feet—perfect for finding directions on



the Interstate or marking geologic formations, but not precise enough for locating street addresses. Still, considering the price tag, this card was amazingly accurate.

The precision of Socket's GPS card was equaled only by the level of difficulty in its configuration and use. The DOS-based setup program required us to strip the native PCMCIA Socket Services from our NCR Safari 3180 notebook, rendering the modem in the system's other Type II slot useless. The automatic installation program yielded frustration at first, but after a few tries the GPS card worked well—if a little slowly.

After between 2 and 5 minutes, the card locked onto the three satellites required to locate longitude and latitude and displayed the location to thousandths of minutes. Access to a fourth satellite is needed to plot altitude. Once you've established position, Socket Communications' GPS program will estimate course and speed based on two or more position markings. The software's only shortcoming is its lack of even rudimentary maps, although you can transfer a position reading to an external mapping application.□

Benchmark Tests: PCMCIA Cards

PCMCIA cards pack a great deal of technology into a package not much larger than a credit card. How do these cards compare with each other, and how do they rate against their full-size counterparts? *PC Magazine* took a close look.

COMPATIBILITY TESTS

Our four compatibility-test machines were an AST PowerExec 4/25SL Color Plus, an IBM ThinkPad 720C, a NEC UltraLite Versa 25C, and a Toshiba T4600C. These four machines used three different PCMCIA controllers: the Intel 82365SL, Toshiba's ToPIC (an Intel clone), and IBM's PCMCIA Controller Chip. Right now, the Intel chip is the industry standard for PCMCIA controllers.

The Toshiba chip is part of the IC Card Gate Array chip set found in the Toshiba T4600C. Like the Intel chips, it is based on the ISA bus. The IBM chip is also modeled on the Intel chip but uses IBM's Micro Channel bus, which caused a few problems with modem-card enablers that were specifically looking for the Intel chip registers.

HARD DISKS

We tested hard disk PCMCIA cards using the disk test suite from PC Labs' PC Bench 8.0. The PC Bench disk score gauges the performance of a PC's disk subsystem, which includes the hard disk, disk controller, and any hardware or software disk caches. The tests that produce this score work with over 100 files in six directories, totaling over 30MB. The tests include file reads, writes, creations, and deletions in a mix based on the disk usage of a set of popular applications. We tested all the hard disks with a 2MB SmartDrive software cache enabled. We also tested a conventional Toshiba 120MB internal IDE hard disk for comparison.

MEMORY CARDS

We compared the reading and writing capabilities of nine PCMCIA cards—eight SRAM cards and one flash-memory ATA card—by sending a 2MB Microsoft Word test file three times to and from a Toshiba T4600C notebook's internal hard disk. Four additional cards, three SRAM and one flash-memory, could not complete our tests.

MODEMS

We created a host system using a 14,400-bps Hayes Optima desktop modem and Datastorm Technologies' Procomm Plus for DOS (communications software). We uploaded and downloaded a Type V test file three times across the modem connection and timed the transfers with a stopwatch. A Type V file combines text, machine language, assembly code, and noncompressible null characters. We designed the file so that the receiving modem would not be able to receive every byte of the file on the first or successive passes.

TEST RESULTS

We had few installation or initialization problems with the memory cards; either they worked or they didn't. For SRAM cards, all that is normally required is PCMCIA Card and Socket Services. Theoretically, flash-memory cards should work this way as well, but almost none of them could. Vendors blamed this on "chip incompatibilities," which means that the EEPROMs found in flash-memory cards are programmed to be compatible with a particular PCMCIA host-adapter chip set. All four compatibility test systems' host adapters were Intel or Intel-compatible (the most popular type of PCMCIA adapter to date); most of the cards we tested were not Intel-compatible. Only the SunDisk SDP Flash Card worked.

The memory cards produced results that were remarkably similar. The only exceptions were the cards from Panasonic Industrial Co. and Simple Technology, which lagged just slightly behind the other cards on the read test and significantly behind on the write test. Reads are inherently slower than writes because after the cards read the test data, they have to write it to the IDE hard disk in the Toshiba notebook. SunDisk Corp.'s flash-memory card lagged behind all the SRAM cards, but that was due to its use of flash-memory technology. Flash-memory chips are slower, but they're also cheaper and use less power than SRAM chips.

For modems, compatibility rests not with Card and Socket Services but with other software called *card enabler drivers.* Many modem cards use enabler programs to bypass Card and Socket Services and communicate directly with the PCMCIA host-adapter controller.

The critical issue here is how those enablers interact with a notebook's PCMCIA controller. Host adapters from Intel and Toshiba will work with SystemSoft drivers, which are necessary to implement SRAM and flash-memory cards. For the IBM system to utilize Card and Socket Services, a Chip ID switch must be added to the socket-service device listed in the notebook's CONFIG.SYS files. In any case, enablers completely preclude hot swapping because they require a system reboot.

For modem cards in each of the transfer-rate categories, upload and download times were within seconds of each other.

Hard disk cards are completely dependent on Card and Socket Services as well as on an extra set of drivers providing the ATA interface, which proprietary drivers such as IBM's and Toshiba's cannot provide. The Toshiba product, however, is fully compatible with Card and Socket Services. As a result, hard disk cards worked on the NEC and Toshiba notebooks but not on the IBM. Theoretically they would have worked on the AST notebook, but the drives cannot fit into this portable's Type III slot.

PCMCIA's System Architecture

by Nick Stam

What made the Personal Computer Memory Card International Association's Release 2.0 specification so exciting was that it was designed to provide standardized operation for all PCMCIA products. According to the specification, PC Cards adhering to proper design specifications should work in all systems using PCMCIA specification–compatible system software and hardware.

Unfortunately, some elements of the specification were loosely defined. What exists today in the PCMCIA arena is a confusing collection of system software and support hardware. Compatibility is still a real problem, and most PC and system notebook vendors are publishing PC Card compatibility lists for their products. Some system software vendors are developing standardized PCMCIA software and are improving the situation. To help you make sense of what is required from both your PCMCIA card and your notebook, *PC Magazine* has compiled a short list of all the layers in a working PCMCIA model.

THE HOST ADAPTER

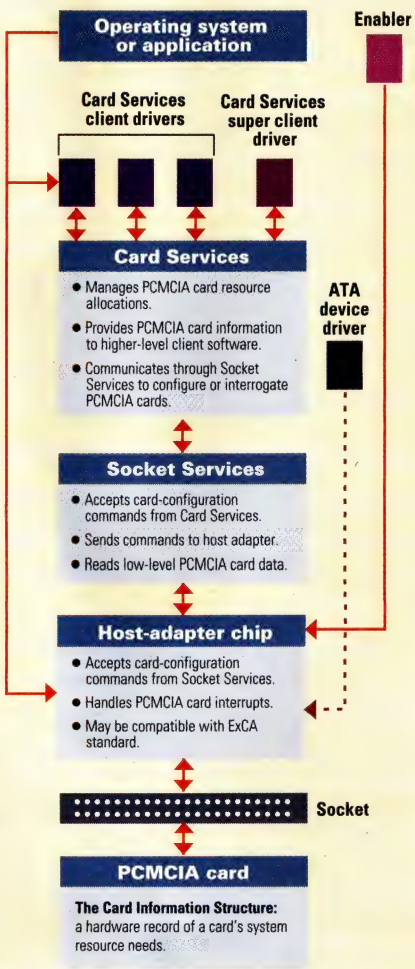
Notebooks with PCMCIA expansion sockets include an interface chip called a *host adapter* that connects the expansion bus to one or more (usually two) 68-pin PCMCIA sockets. Many chip makers provide host adapter chips, but the majority of systems currently use Intel's 82365SL chip.

Host adapters are configured to respond to particular system I/O and memory ranges to satisfy the requirements of installed PCMCIA cards. Host adapters also handle interrupts generated from PC Cards and some provide power-management functions. Adapters will typically contain address and data buffers to handle hot swapping.

SOCKET SERVICES

Socket Services is the lowest layer of the PCMCIA system software architecture. Its prime function is to relay commands between Card Services (see below) and the host adapter. It is hardware dependent, as different versions or configurations of Socket Services software are required to communicate with different host adapter chips.

Under the control of higher-level software such as Card Services, Socket Services configures the host adapter to operate properly with the PC Card and also reads low-level timing and configuration information from a PC Card's CIS (Card Information Structure, a hardware record of system resource needs). Socket Services software is often installed in RAM, but it can also be run from ROM.



CARD SERVICES

The Card Services specification is the highest-level software layer in the PCMCIA specification, managing PC Card resources from a system-wide perspective. In a perfect world, it would talk to your card's CIS to find out exactly what system resources are needed. What often occurs is that a higher-level Card Services client driver performs this function (see below) and then informs Card Services of its requirements. Card Services stores this information in a resource table and then informs Socket Services of the request through the Socket Services API (application programming interface).

Some PCMCIA products and drivers bypass Card Services (see below), but generally usage of Card and Socket Services is critical to PC Card compatibility, interchangeability, and the ability to insert and remove cards without the need to reboot the host PC.

DRIVER MADNESS

The PC Card drivers that exist above Card and Socket Services can generally be broken down into four categories: generic device drivers, Card Services client drivers, enablers, and super client drivers. Some drivers specifically use Card and Socket services, playing by the rules, and others bypass these services entirely. As a rule of thumb, if your card requires you to reboot the system, then it's not Card and Socket Services compliant.

A confusing aspect of using the term "driver" when referring to PCMCIA system software is that in most cases these drivers only assist in installing and configuring the PC Card for use by a "real" driver, an application, or an operating system. Typically, once PC Cards are installed and configured,

Card and Socket Services moves out of the picture during actual use.

FOUR DRIVER FLAVORS

There are four general flavors of PCMCIA device drivers. *Generic device drivers* initialize PC Cards that perform well-defined functions, such as SRAM or ATA (AT Attachment protocol) hard disk cards. These cards tend to have standardized interfaces and will operate in most PCMCIA systems that have Card and Socket Services installed, although they may not use those services directly. Generic drivers are not necessarily shipped with a PC Card, but are often shipped with the PC system or Card and Socket Services software.

Card Services client drivers tend to be card-specific drivers that use Card and Socket Services and perform card initialization and resource management functions.

Enablers also tend to be card-specific drivers, but they communicate directly with the host adapter, bypassing Card and Socket Services. Unfortunately, enablers are the most popular kind of driver in use right now, especially for products like modems and some solid-state storage devices, and they don't allow hot swapping of PC Cards.

Super client drivers are capable of recognizing and configuring a great many cards with the assistance of Card Services. Super client drivers are often shipped with PC systems or supplied by Card and Socket Services software vendors like SystemSoft and Phoenix.

EXCA SPECIFICATION

The ExCA (Exchangeable Card Architecture) specification was initially defined by Intel to assist in PC Card and system interoperability for its 82365SL Host Adapter. ExCA defines a minimum set of software and hardware requirements for PCMCIA software and hardware. Intel has decided to throw its weight behind PCMCIA's specifications and has handed over ExCA to the association.□

modem and liked it.

Most of these PC Card modems ran at 14,400 bps; 9,600 bps seems to have missed its opportunity in the PC Card area, though we did get one. Don't let their size fool you; these products mirrored their full-size counterparts in actual use. Things to look for include a software bundle—the well-packaged products all had bundled communications and fax software—a long warranty (five years is not unusual), and the ability to hook into a cellular telephone. Modems that were cellular-ready were AT&T Paradyne's KeepInTouch card, Hayes's Optima, and MagicRAM's product. Keep an eye out for sleep modes as well: Most had at least two levels of power consumption, and some even had three, but a few had none.

Intel's product will be sold to OEMs and separately marketed by Intel. The product should be hitting the market by the time this issue hits the newsstand. The MagicRAM product is also voice-capable, so you can use your notebook as an answering machine. The TDK entry came with an old-fashioned phone coupler, included for those who travel abroad. Only Megahertz's entry (utilizing the company's patented XJack technology) and Angia Communications (taking advantage of Toshiba's "Type IV" slot width) entered modem solutions with internal RJ-11 jacks.

In our performance tests, we recorded upload and download times over three tries to come up with an average. All of the 14,400-bps products maintained the same pace as a standard Hayes external modem being run through the serial port. We also ran the Hayes through Socket Communications' PCMCIA serial interface card and obtained similar results.

As we were going to press, Megahertz had just initiated a price war on the PCMCIA modem front by dropping prices on its 14,400-bps XJ1144 product (tested here) from $599 to $399. Prices for competing modems should change dramatically by the time you read this.

SOLID STATE STORAGE

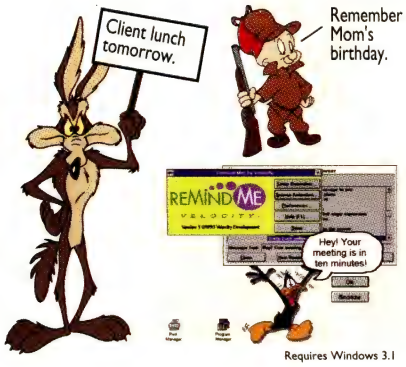
We snagged 13 solid-state memory cards. Ten of these used SRAM (static RAM) memory chips, while the others relied on flash technology. The differences here are both theoretical and realistic. Theoretically, flash technology has advantages over SRAM, as it is cheaper and doesn't need a lithium battery inside the card (that means a smaller form factor, too). But only one of the flash cards we received, the SunDisk Corp. card, was able to function with our test systems. These memory cards are both the easiest and the most frustrating PCMCIA cards to use. Since they require no configuration driver, they'll either work with your system automatically or they won't. Storage size of the tested cards stayed within the 1MB to 5MB range, though companies such as SunDisk now have products with much larger capacities.

The problem is price. Whether using flash, SRAM, DRAM (dynamic RAM), or some other kind of memory media, the cost of PCMCIA-based solid-state storage is still about $100 per megabyte—nearly 100 times the cost of a hard drive. You should see some change in the pricing next year, but don't expect it to fall too much.

Power consumption is a hot topic in this forum. Though more versatile in the long run, flash cards run at 12 volts right now and require hefty external juice. Silicon Storage Technology (SST) recently announced the industry's first storage cards capable of running at 3.3 volts. Unfortunately, this technology has only been available for certain PDA products, so we were unable to test it for this review. SST uses the Fowler-Nordheim tunneling mechanism to provide more efficient onboard voltage multipliers. Basically, these allow the cards to run at either 3.3 or 5 volts for both writing and erasing operations.

Manufacturers represented here ran the gamut from SunDisk, Boca Research, and American Microsystems to better known consumer electronics companies like Panasonic and Hitachi America.

Our Contributors: OLIVER RIST is a staff writer at *PC Magazine*. NICK STAM is a technical director at PC Labs. BEN MILLER is an associate project leader at ZD Labs. Brian Nadel is an associate editor at *PC Magazine*. ROBERT S. ANTHONY is a senior writer at *PC Magazine* and was in charge of this story.



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CIRCLE 121 ON READER SERVICE CARD

PCMCIA Add-In Card Compatibility: No Guarantees

When it comes to compatibility between machine and card, check before you buy.

■ = YES ☐ = NO	AST PowerExec 4/25SL Color Plus	IBM ThinkPad 720C	NEC UltraLite Versa 25C	Toshiba T4600C
Hard Disks				
Intégral PocketFile 42	N/A	■	■	■
Intégral PocketFile 85	N/A	N/A	N/A	■
Maxtor MXL-105-III	N/A	■	■	■
MiniStor MP42P	N/A	■	■	■
MiniStor MP85P	N/A	N/A	N/A	■
Memory Cards				
American Microsystems 2MB Flash Card	☐	☐	☐	☐
American Microsystems 2MB SRAM Card	■	■	■	■
Boca Sea Disk (SRAM)	■	■	■	■
Epson RAM Card (SRAM)	■	■	■	■
Hitachi 2MB SRAM Card	■	■	■	■
MagicRAM Dual Battery SRAM Card	■	■	■	■
Mitsubishi 2MB PCMCIA SRAM Memory Card	■	☐	■	■
Panasonic 4M Byte SRAM Card	■	■	■	■
Simple Technology HP95LX SRAM	■	■	■	■
Simple Technology Toshiba SRAM	■	■	■	■
Smart Modular Technologies 2MB SRAM Card	■	■	■	■
Smart Modular Technologies 4MB Flash Card	☐	☐	☐	☐
SunDisk SDP Flash Card	■	■	■	■
Modems				
Angia PCMCIA Toshiba Type IV/16mm Fax Modem	N/A	N/A	N/A	■
Angia PCMCIA Type II Fax Modem	■	■	■	■
Apex High Speed Data Fax Modem	■	■	■	■
AT&T KeepInTouch Card	■	■	■	■
Data Race RediCARD	■	☐	■	■
Epson EFM 144	■	■	☐	■
Hayes Optima 14.4 PCMCIA	■	☐	■	■
Intel PCMCIA Faxmodem 14.4/14.4	■	☐	■	■
MagicRAM 9624 Mercury Card	■	☐	■	■
Megahertz XJ1144	■	☐	■	■
Practical Peripherals PractiCARD 144	■	■	■	■
Smart Modular Technologies ST 1414	■	■	■	■
TDK DF1414 DirectConnect Data Fax Modem Card	■	■	■	■
I/O Adapters*				
Socket Serial I/O Credit Card Adapter	■	■	■	■

N/A—Not applicable: The system's slots are not the right size for this card.

* The New Media Visual Media SCSI Adapter Card did not arrive in time for testing.

Advanced Micro Devices and Maxell also make flash memory cards, but both companies declined to participate.

There were two developments in this arena at press time: First, Quantum Corp. had just announced an agreement with SST to develop solid-state storage under the Quantum name—look for the results of this venture early next year. Recently announced SST products may come under this agreement. SunDisk also announced the availability of an unprecedented 40MB of storage (expandable to up to 80MB with preloaded data-compression software) on its newest flash card product. Available next quarter, this product has no official retail price yet, but the initial sample price was set at $1,995.

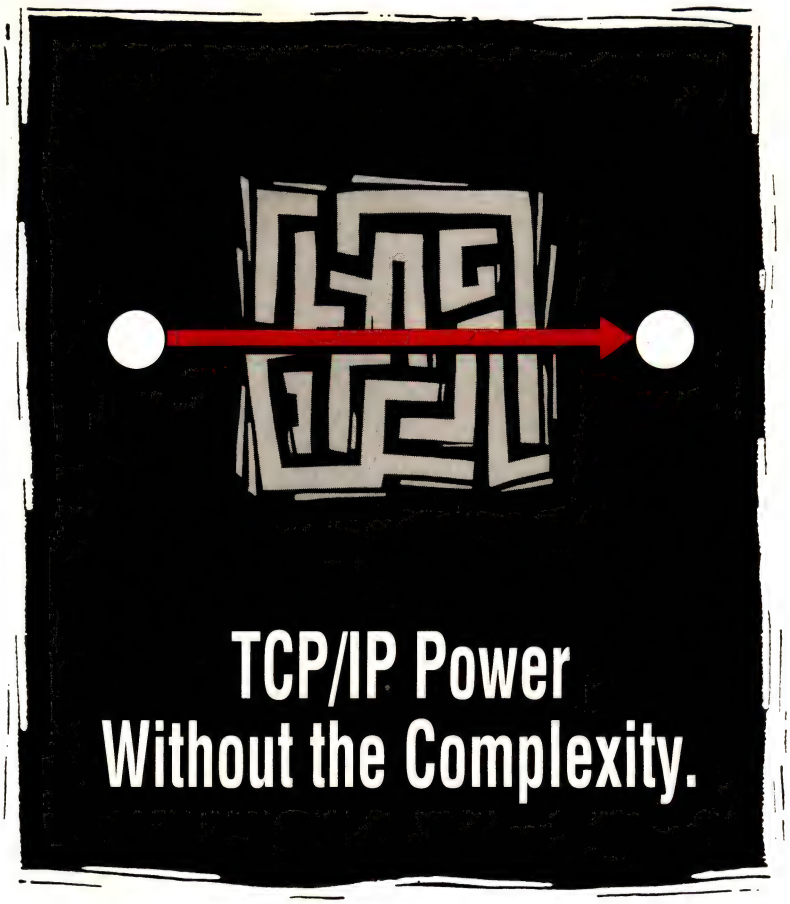
Timings on read and write tests for a standard Microsoft Word file were fairly consistent. The Simple Technology product ran slightly faster than its competitors, but the difference isn't significant. Because SunDisk's product used flash technology, it rated slower performance. As flash makers are quick to point out, however, this technology will still dominate because it is cheaper and uses less power—no lithium battery required. Again, however, the difference was less than 3 seconds for a 4 minute sequence.

EVERYTHING ELSE

We accepted five mini-hard disks as well as a serial interface card from Socket. The hard disks came from Integral Peripherals, Maxtor Corp., and MiniStor Peripherals Corp. All of these latter products shipped with device drivers and a list of compatible notebooks. Western Digital has a PCMCIA hard disk designed exclusively for the HP

PathWay Access

- Terminal Emulations:
  - VT100-340
  - TN3270, 3179G
  - Tektronix 4105/4010
- FTP Client/Server
- SMTP/POP/IMAP/NNTP
- LPR/LPD/IPR
- 4.3BSD and Windows Sockets
- NetBIOS
- NDIS/ODI/PDS/ASI
- SLIP/PPP/X.25
- MIBII SNMP Agent
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- Coexists with any NOS
- Graphical Keyboard Remapper
- NFS Client & Server
- Extensive DBMS support



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PCMCIA PRODUCTS AND FEATURES

HARD DISKS

	Telephone number	Slot size	PCMCIA version	Capacity	Price	Disk score (PC Bench 8.0)
Intégral PocketFile 42	303-449-8009	Type III	Release 2.0	42MB	$499	266
Intégral PocketFile 85	303-449-8009	Proprietary	Release 2.0	85MB	$699	264
Maxtor MXL-105-III	800-462-9867	Type III	Release 2.0	105MB	$495	284
MiniStor MP42P	800-943-0165	Type III	Release 2.0	42MB	$449	289
MiniStor MP85P	800-943-0165	Proprietary	Release 2.0	85MB	$549	285
Toshiba Internal IDE ❶	———	———	———	120MB	———	426

I/O ADAPTERS

	Telephone number	Slot size	PCMCIA version	Connector size	Interface	Price
New Media Visual Media SCSI Adapter Card ❷	800-453-0550	Type I	Release 2.0	Centronics 50-pin	SCSI	$339
Socket Serial I/O Credit Card Adapter ❸	510-670-0300	Type II	Release 2.0	DB-9	Serial/RS-232	$215

MEMORY CARDS

	Telephone number	Slot size	PCMCIA version	Capacity	Price	Average read time, 2MB file (seconds)	Average write time, 2MB file (seconds)
American Microsystems 2MB Flash Card	208-234-6661	Type I	Release 2.0	2MB	$333	N/A	N/A
American Microsystems 2MB SRAM Card	208-234-6661	Type I	Release 2.0	2MB	$288	N/A	N/A
Boca Sea Disk (SRAM)	407-750-1528	Type I	Release 2.0	2MB	$350	4.73	1.55
Epson RAM Card (SRAM)	800-922-8911	Type I	Release 2.0	2MB	$349	4.80	1.45
Hitachi 2MB SRAM Card	800-297-1601 ext. 16	Type I	Release 2.0	2MB	$575	4.77	1.56
MagicRAM Dual Battery SRAM Card	800-272-6242	Type I	Release 2.0	2MB	$325	4.64	1.37
Mitsubishi 2MB PCMCIA SRAM Memory Card	408-730-5900	Type I	Release 2.0	2MB	$225	N/A	N/A
Panasonic 4M Byte SRAM Card	201-348-5266	Type I	Release 1.0	4MB	$1,300	4.86	4.83
Simple Technology HP95LX SRAM	800-367-7330	Type I	Release 2.0	1MB	$155	4.71	1.39
Simple Technology Toshiba SRAM	800-367-7330	Type I	Release 2.0	2MB	$389	4.27	8.50
Smart Modular Technologies 2MB SRAM Card	800-536-1231	Type I	Release 2.0	2MB	$299	4.69	1.42
Smart Modular Technologies 4MB Flash Card	800-536-1231	Type I	Release 2.0	4MB	$375	N/A	N/A
SunDisk SDP Flash Card	408-562-0500	Type II	Release 2.0	5MB	$375	7.02	28.67

MODEMS

	Telephone number	Slot size	PCMCIA version	Data speed/ fax speed (bps)	Price	Average download time (minutes: seconds)	Average upload time (minutes: seconds)
Angia PCMCIA Toshiba Type IV/16mm Fax Modem	800-877-9159	Proprietary	Release 2.0	14,400/14,400	$465	1:05	1:09
Angia PCMCIA Type II Fax Modem	800-877-9159	Type II	Release 2.0	14,400/14,400	$445	1:16	1:29
Apex High Speed Data Fax Modem	800-841-2739	Type II	Release 2.0	14,400/14,400	$399	1:31	1:24
AT&T KeepInTouch Card	800-482-3333	Type II	Release 2.0	14,400/14,400	$449	1:03	1:09
Data Race RediCARD	800-749-7223	Type II	Release 2.0	9,600/9,600	$399	1:38	1:35
Epson EFM 144	800-922-8911	Type II	Release 2.0	14,400/14,400	$439	1:21	1:24
Hayes Optima 14.4 External Modem ❶	———	———	———	14,400/14,400	———	1:03	1:08
Hayes Optima 14.4 Internal Modem ❸	———	———	———	14,400/14,400	———	1:03	1:09
Hayes Optima 14.4 PCMCIA	404-441-1617	Type II	Release 2.0	14,400/14,400	$499	1:19	1:09
Intel PCMCIA Faxmodem 14.4/14.4	800-538-3373	Type II	Release 2.0	14,400/14,400	$399	1:06	1:05
MagicRAM 9624 Mercury Card	800-272-6242	Type II	Release 2.0	2,400/9,600	$349	4:50	4:51
Megahertz XJ1144	800-527-8677	Type II	Release 2.0	14,400/14,400	$399	1:21	1:23
Practical Peripherals PractiCARD 144	800-442-4774	Type II	Release 2.0	14,400/14,400	$449	1:18	1:10
Smart Modular Technologies ST 1414	800-536-1231	Type II	Release 2.0	14,400/14,400	$399	1:08	1:07
TDK DF1414 DirectConnect Data Fax Modem Card	800-999-4835	Type II	Release 2.0	14,400/14,400	$499	1:11	1:28

N/A—Not applicable: The product was not compatible with this test.

❶ For comparison, we are reporting selected information about this product.

❷ The New Media SCSI Adapter Card did not arrive in time for testing.

❸ We tested the Socket Serial I/O Credit Card Adapter in conjunction with the Hayes Optima 14.4 External Modem (below).

OmniBook subnotebook. This disk provides primary storage for that product while its true PCMCIA socket should be used for something else.

Now, we know what you're thinking: "If solid-state cards are slimmer and less susceptible to damage, and will eventually have more capacity than hard disks, why did these people bother?" That question, however, is based on a misconception. You can buy 85MB of hard disk storage for a relatively affordable price today. Presently, you can't get 85MB on a flash or SRAM card and even if you could, it would cost you around $8,500. Both PC Card hard disk sellers and PCMCIA solid-state makers agree: These products address different market needs and should be able to cohabit nicely for some time.

Testing, using ZD Labs standard PC Bench 8.0 Disk Mix test, showed good performance for all the drives. We tested the Socket serial interface card by hooking a standard Hayes 14,400-bps external modem to it. You can compare these scores to the results of the same modem hooked to a standard serial port, reported under the modem features/performance table.

New Media Corp. was supposed to send us the latest version of its SCSI port interface card, but missed our deadline. Once the product arrived, though, we found it satisfactory in casual use. We did include it in our Summary of Features table.

Modems are flooding the market as well. Aside from the ones we tested, at press time there were 14,400-bps-capable products available from Best Data Products (800-632-2378), Compaq Computer (800-888-5858), GVC Technology (800-289-4821), and U.S. Robotics (800-342-5877).

Though they've demonstrated them at PC Expo and IC Card Expo, neither New Media nor IBM Microelectronics managed to have a PCMCIA sound card ready in time for this story. Look for such products at Fall Comdex.

USING THE SUMMARY OF FEATURES TABLE

Unlike a standard *PC Magazine* product review, we decided not to include separate product reviews for each entry. In most instances these would have been too repetitive. Instead, we've included separate features tables for modems, memory cards, and the "specials" (hard disk and interface cards).

On these charts you'll find each product's name, the company sales telephone number, price, product specifications (capacity for hard disks and memory cards, baud rate for modems, and so forth), and the throughput test scores. What these numbers represent is described in the introduction to the benchmark tests.

WHAT TOMORROW HOLDS

Though LAN adapters, modems, and solid-state storage are the mainstays of PCMCIA sales right now, that will change soon. Creative engineers like those at New Media and IBM Microelectronics in Canada are constantly inventing new ways to use this technology. As an example, check out the sidebar "GPS on a Notebook" where a *PC Magazine* editor ventures into his back yard with Socket Communications' Mobile GPS, a PCMCIA-card that uses the Defense Department's Global Positioning Satellite network.

Big trends in new cards will include sound and solid-state storage. Sound is being addressed by numerous vendors—look for announcements around the time of Fall Comdex. Solid-state storage is set to undergo a major revision by New Media's engineers. The folks there are touting a new form of layered media that will allow up to 400MB in a Type I–size card by the end of 1994. Cost is still undisclosed and will certainly be a factor, but New Media says it wants this technology to become popular, so who knows?

Another application for PCMCIA that has been discussed from the beginning, but only slowly implemented, is as ROM software using the Execute in Place feature. To implement this feature, a manufacturer would store an application on a PC Card in ROM and maybe add some RAM for personal data files. What's holding this technology back is the prohibitive cost of memory media in the PC Card format and the

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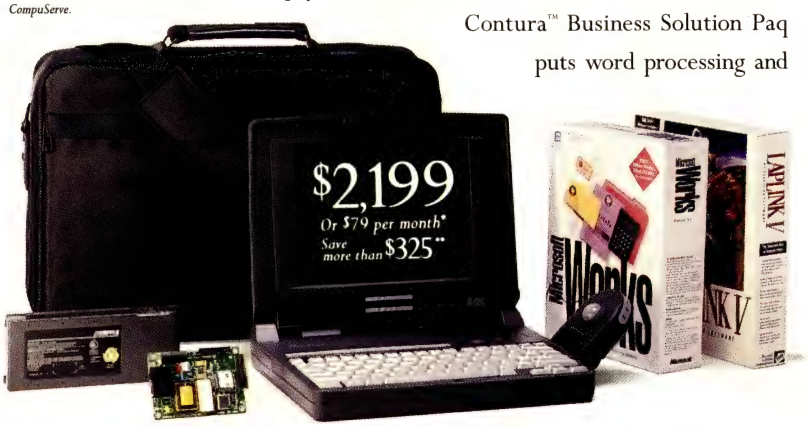
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necessary licensing agreements from software companies.

Hewlett-Packard's display of PCMCIA card technology on the desktop is only the beginning. Representatives of PCMCIA and the committee that designed the new PCI local-bus standard have had their heads together for a while creating a bridge between the two buses. Look for some exciting developments here when PCI-bus systems start to hit the market. Local-bus technology opens the doors for a closer marriage of portable and desktop systems, including local-bus video and hard disk controllers—the next generation of docking station could be radically different.

Also, look for PCMCIA technology to really take off when the consumer electronics people step in. As Socket's GPS product demonstrates, the uses for PCMCIA are limited only by an engineer's imagination. Rumor has it that a version of the GPS card might appear in a big-name American car. Other commercial uses include portable phones, personal health-care data carriers, and yet one more medium for on-the-go video entertainment.

What you need to understand is that this technology is here to stay. Whether it revolutionizes PCs or not, it's had a powerful influence on the notebook market already and will continue to do so. Investors are spending millions on this technology and sprouting companies like SunDisk (Santa Clara, California), New Media (Irvine, California), MagicRAM (Los Angeles, California), Megahertz (Salt Lake City, Utah), and Socket Communications (Hayward, California) are exploiting it as their primary or sole business.

Major players such as Hewlett-Packard, Intel, IBM, Maxell, Verbatim, and even Microsoft have invested heavily in this arena as well. PCMCIA chapters are active in Japan, Taiwan and, most recently, in Europe. Numerous companies in all of these locales are creating compatible products.

Some of you might not need PCMCIA's flexibility for your portable computing today, but don't ignore it just because you think it's too messy to succeed. The system works today and it's only going to work better tomorrow. □

PCMCIA LAN ADAPTERS



Compact Connections

This crop of PCMCIA-standard Ethernet and Token-Ring adapters all derive from a handful of chip set producers and original card manufacturers.

by O. Ryan Tabibian

It was inevitable. The explosive popularity of notebook-size PCs has combined with the explosive proliferation of LANs to create a rich market for network adapters that better suit the smaller, slicker systems. The ability to plug your notebook PC in to your branch office network has for some become a standard way of conducting business. For a time, the only option for making this connection was a traditional external parallel-port adapter, which didn't perform as well as its desktop counterpart and was somewhat cumbersome to carry. Rare is the person who wants to bother with a peripheral

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Illustration by David Kahl

PC MAGAZINE

EDITORS' CHOICE

- *For Ethernet* ..... **InfoMover NE4100 PCMCIA Ethernet Adapter**
- *For Token-Ring*..... **IBM Token Ring 16/4 Credit Card Adapter**

Performance and compatibility results for the tested PCMCIA LAN adapters were so similar—for both Ethernet and Token-Ring cards—that they are nonissues. In naming our Editors' Choices we considered other aspects that are pertinent to buyers including good support, conformance with current PCMCIA committee standards, specifications, ease of installation, and price.

For both network categories, in addition to other compelling reasons, we chose products from vendors that were also the original equipment manufacturers (OEMs) of the chip sets, the cards, or both, for their own products and for other vendors in the roundup. (For Token-Ring adapters, IBM designs and manufactures the board used for its own card and all three other represented products.)

The InfoMover NE4100 PCMCIA Ethernet Adapter from National Semiconductor lists at $249, one of the lowest prices in this field, and it offers a good combination of more than a few of the better support features. It already supports release 2.01 of the PCMCIA standard (which adds certain fixes to the I/O card specifications), and National Semiconductor provides a lifetime warranty, a BBS, and 24-hour technical support, 7 days a week. And the installation was so simple that we didn't even need to refer to the well-organized documentation. InfoMover's resource allocation utility even determines which I/O port and interrupt are available on the system.

The IBM Token Ring 16/4 Credit Card Adapter carried the lowest list price—at $575—of the four Token-Ring cards we tested in this early PCMCIA roundup. And it comes with an installation program as well as 24-hour technical support, 7 days a week and a 5-year warranty—as long or longer than any of the other reviewed products' warranties. It also has excellent documentation.

for his notebook PC that rivals it in size, weight, or cost.

We've reviewed the first full crop of Ethernet– and Token-Ring– PCMCIA-format LAN adapters. When the dust settled over our test-bed, we discovered that the principal consideration in choosing a PCMCIA LAN adapter is neither performance nor compatibility; the cards all turned in about the same results in those areas. Rather, buyers should look to price, ease of installation, and quality of technical support to make their choices. We tested 15 Ethernet adapters and 4 Token-Ring adapters, all of which derive from components made by a handful of chip set producers and original equipment manufacturers (OEMs).

PCMCIA technology has evolved over the past few years. Although at first hampered by compatibility issues, PCMCIA peripherals have begun to gain momentum in the notebook and PDA (personal digital assistant) markets. PCMCIA slots are also beginning to show up on desktop machines, such as the IBM E-Machine.

With all these changes, the PCMCIA standards committee has had to make its own adjustments. In 1989 the committee defined release 1.0 for memory-only interface cards. These were to be about the size of credit cards, but with various thicknesses. The initial release specified Type I cards to be 3.3 mm thick. Type II cards, which appeared shortly thereafter, measured 5.0 mm, and were used mostly for LAN adapters and modems. Type III cards—10.5 mm thick—were designed for even more complex applications, such as hard drives. All the cards use a 16-bit interface. (The PCMCIA committee has plans to release the standard for 32-bit bus–mastering versions of the cards sometime in 1994.)

HIGHLIGHTS

PCMCIA LAN Adapters

SMALL, LIGHT, AND QUICK, a PCMCIA adapter is the natural companion for today's notebook computer. Though compatibility with standards was once an issue, most vendors now comply with the existing specifications. And with throughput all but equal from vendor to vendor, price, support, and ease of use are important considerations.

THERE ARE TWO OTHER FLAVORS of portable network adapters: parallel port and wireless. Each has its own advantages and disadvantages in price, speed, size, and portability. Parallel-port adapters are inexpensive compared with their PCMCIA counterparts, but throughput is hampered by the port itself. New technologies promise to help, and for now this is the adapter of choice for a notebook that has no available PCMCIA slots.

WIRELESS ADAPTERS are useful for portable machines or desktop systems. A PCMCIA adapter using spread-spectrum radio technology allows free movement around an office or campus, while a card using infrared technology eliminates the need for costly wiring of desktop machines, though you pay the price in transmission range.

In addition to PCMCIA, the ExCA (Exchangeable Card Architecture) specification, designed by Intel, also sets standards for credit-card-size peripherals. Both Intel and the PCMCIA committee are working to merge the two standards. The initial goal of the ExCA specification was to facilitate "plug and play" operation by implementing hot swapping as well as Card and Socket Services (a software layer between the PCMCIA hardware and the application, defined by the PCMCIA committee).

To add to the confusion, some vendors, such as Toshiba, have begun to deviate from the PCMCIA committee standards. Toshiba introduced a proprietary 16-mm slot (not to be confused with the PCMCIA committee's proposed, but rejected, Type IV slot), to accommodate larger hard drives and modems. If you're in the market for a notebook computer with PCMCIA slots, it's best to make sure that the notebook is compatible with the PCMCIA committee specifications. (For a comprehensive review of notebook computers, see the August 1993 issue of *PC Magazine.*)

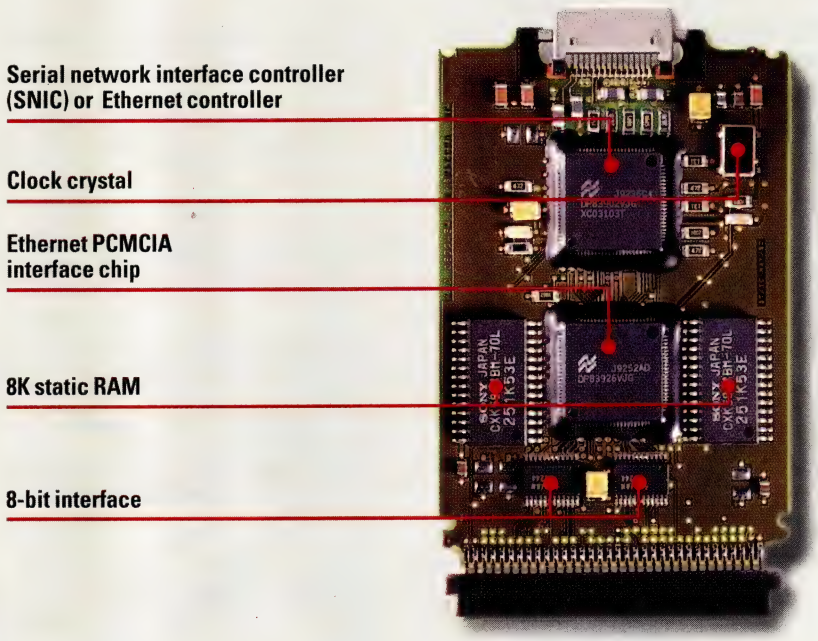
The PCMCIA committee defined the Card Services and Socket Services (CS/SS) in response to the growing concern over compatibility. Card Services allows the software to access the PCMCIA card without having to understand the underlying hardware. Socket Services facilitates Card Services by sending transactions over the bus. Many notebook vendors are planning to include Card and Socket Services in their BIOS, to permit true "plug and play" among PCMCIA cards. (For details on Card and Socket Services, see "PCMCIA: Power and Potential" in this issue.)

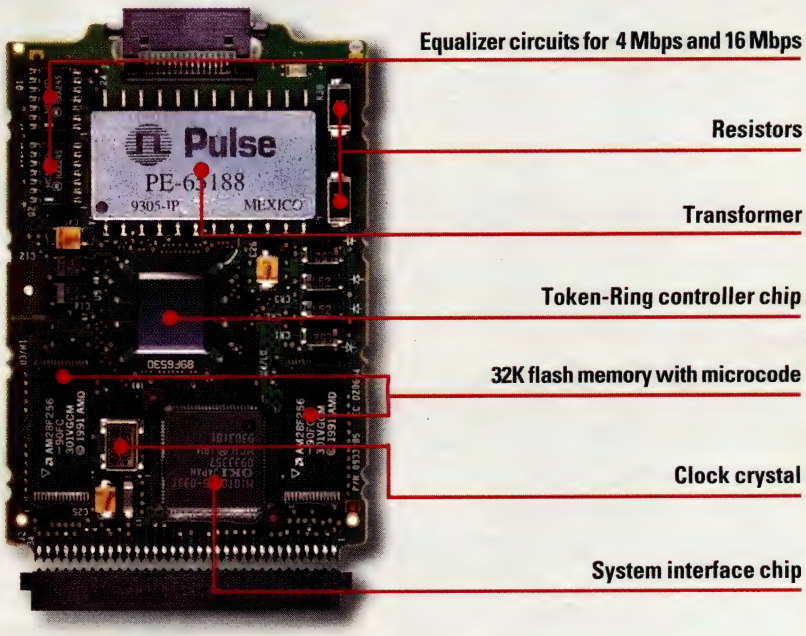
PICK A CARD, ANY CARD

We found little performance difference among these cards, regardless of price, manufacturer, or vendor. And compatibility turned out not to be an issue either, mostly because there are only a handful of OEMs. Many of the cards we tested are being marketed by companies that merely stick on their own label. In fact, we found only one compatibility problem: On the IBM ThinkPad 720C, the New Media Ethernet LAN Adapter initialized, but we could not log on. (We alerted New Media, which is checking into the prob-

Compact Components

The miniaturization of add-ons, such as the PCMCIA-format Token-Ring and Ethernet adapter cards shown below, has followed that of systems and their components. The industry basically doubles the number of gates on a given piece of silicon about every 18 months. This tighter integration means more capability in less geography. So it goes with the specialized chips that provide other services, from video to communications, including the network adapter chips used on these cards.





lem and will probably have fixed it by the time you read this.)

As we ran our benchmark tests, not only did we find little or no difference in card performance (see the benchmark tests sidebar), but many looked the same and had similar drivers and installation programs. Some even had identical manuals. To clear up a bit of the confusion, we opened each card to check the chip set. Among the 15 Ethernet PCMCIA cards, there were only three OEMs. Nine of the vendors used cards designed by National Semiconductor and licensed for manufacturing to IBM. IBM uses an extremely precise laser welding technology that completely wraps the card in steel, making these cards quite durable. Three vendors—Addtron Technology Co., D-Link Systems, and Linksys—use cards designed by D-Link. Xircom designs and manufactures its own card. (Socket Communications and New Media Corp. use a slightly modified version of the National design.)

The chip sets on all of the cards were designed by either National Semiconductor or Fujitsu. (Intel will be releasing a card based on its own chip set in the near future.) The National/IBM and D-Link cards use National chip sets, whereas the Xircom CreditCard Ethernet Adapter uses Fujitsu's. All four Token-Ring cards were designed and manufactured by IBM.

WHAT DO THEY WORK WITH?

Because compatibility has been one of the big issues associated with PCMCIA technology, we tested each of the cards in four different notebook computers with PCMCIA Type II slots: the AST PowerExec 4/33, the IBM ThinkPad 720C, the NEC UltraLite Versa 25C, and the Toshiba T4600. (We ran compatibility tests on all four notebooks; we used only the Toshiba for our benchmark tests.) We chose the AST, IBM, and NEC systems for their broad market appeal, and we included the Toshiba system because it is considered one of the fastest notebooks on the market.

(Note, however, that although we tested all of these cards with all four representative notebook PCs—this is not a blanket statement that all cards and systems are compatible. Particularly with an evolving technology such as PCMCIA, you should still exercise caution and check into compatibility questions before you buy, just as you would with any peripheral.)

The AST and NEC units both use the Intel PCMCIA controller chip, and the Toshiba uses a clone of that chip. IBM also uses a clone of the Intel chip, but one with a Micro Channel bus design. In most of our tests, the cards showed slightly better performance when installed in the IBM ThinkPad.

Overall, however, our testing revealed performance and compatibility to be insignificant as determining factors: what remain for the buyer are price, installation, and technical support. The Ethernet cards we tested range in price from $249 to $499, the Token-Ring cards from $575 to $779. These are sizable differences for such similar performance—particularly to a large organization that must outfit several dozen mobile users. In a smaller firm, with no IS department, installation is likely to be performed by end users, who require a good installation program, clear documentation, and accessible technical

Compact Cabling

There are four types of cabling connections in the PCMCIA LAN adapter market (clockwise from top left): detachable, locking, single unit, and permanent. Most cards have detachable or locking cables, though Socket's is permanently connected. And in every unit except Xircom's, a separate coupler unit is also needed.



What Did We Do Before PCMCIA?

by O. Ryan Tabibian

We did what many people are still doing. PCMCIA is an attractive technology, but many notebook computers—and lots of other larger "portable" computers for that matter—that have already been in users' hands for several years do not have PCMCIA ports. Owners of these systems connect to their networks through traditional external parallel-port adapters. The standard external units do not match the performance or the ease of use of PCMCIA products, but parallel-port adapters do an adequate job. And, by using an Enhanced Parallel Port (see below), you can effectively double each adapter's performance.



External LAN adapters, such as Xircom's popular Pocket Ethernet Adapter III, connect users via the parallel port on notebooks that have no PCMCIA slot, or when that slot is already in use.

Many vendors manufacture parallel-port LAN adapters for use with portable or desktop computers. To get a sampling of performance, we looked at two Ethernet adapters—Xircom's Pocket Ethernet Adapter III and IQ Technologies' pLAN Ethernet Adapter, plus a Token-Ring adapter, Madge Networks' Smart 16/4 Pocket Ringnode.

A lot has changed with many of these adapters over the past few years. They have gotten smaller and lighter, and, in Xircom's case, performance has improved as well. Xircom's original Pocket Ethernet Adapter was bulky and slow, and it required an external power supply. Today, with the introduction of the Pocket Ethernet Adapter III, Xircom has not only made a smaller and faster product, but, to the delight of many networked users, a peripheral that no longer uses an oversize AC converter. Instead, in this generation, the adapter draws power from the mouse port.

IQ Technologies' pLAN Ethernet Adapter is also compact and requires no external power adapter. The Madge Pocket Ringnode, on the other hand, uses an older technology that is apparently licensed from Xircom. (The adapter looks identical to Xircom's older model adapters, with the addition of the Madge Networks logo, and uses the old bulky power converter.)

Xircom, which has the largest market share for parallel port LAN adapters, is continuing its effort to enhance performance and functionality. As part of the effort, Xircom joined forces with Intel Corp. and Zenith Data Systems to create a specification that defines a software/hardware protocol, now part of the IEEE 1284 standard, called the Enhanced Parallel Port (EPP). Historically the parallel port has proven to be the biggest bottleneck for external LAN adapters. EPP was designed to increase throughput dramatically, making it equal to that of an 8-bit internal bus. For EPP to be functional, both the card and the machine must support the standard.

In our tests, we found a dramatic difference between normal parallel-port adapters and those using EPP. In every case performance was doubled with the Enhanced Parallel Port. Granted, the improved performance is not enough to surpass or even to match the performance of the PCMCIA LAN adapters, but the numbers were still respectable. (See the benchmark tests sidebar.)

The majority of high-end notebook systems being shipped today have parallel ports that conform to the EPP specification. Intel has built the EPP circuitry into its 386SL microprocessor, and this is just the beginning. Other chip vendors are expected to follow shortly and build the technology into their own chips. Some systems that don't support EPP do support another method of assuring better performance from your parallel-port LAN adapter: a bidirectional port—one that can send *and* receive 8 bits at a time. (Normal parallel ports can send 8 bits at a time, but they can only receive 4 bits.) But not all parallel-port LAN adapters are compatible with bidirectional ports, so you must be careful to choose an adapter—and system—capable of bidirectional support.

Although they are not as fast as full-blown desktop adapters and not as portable as their PCMCIA cousins, parallel-port LAN adapters will continue to play an important role. At a low cost and a relatively small size, they give older portables and notebooks a dependable way to connect to your LAN.□

ZD Labs Benchmark Tests: PCMCIA LAN Adapters

All the Ethernet and Token-Ring adapter cards tested turned in markedly similar throughput performance. This is not surprising, considering that their components come from a handful of chip set producers and OEMs. But it does mean that buyers should choose based on other issues: price, quality and availability of support, ease of installation, and quality of documentation.

HOW WE TESTED

We used the NIC (network interface card) Throughput test from ZD Labs' NetBench 2.1 to measure the data throughput of the LAN adapters. We repeated the test using various block sizes on Ethernet and Token-Ring test beds. For the test, we used Novell's Open Data-link Interface (ODI) drivers, although most PCMCIA adapters do support NDIS (the Network Driver Interface Specification) and TCP/IP.

Our NetWare 3.11 server was a Compaq Systempro/XL with a 486/50 processor, 32MB of RAM, and a 1GB hard disk. For our server network adapters, we used an Eagle Technology NE3200 in the Ethernet testing and Madge Networks' Smart 16/4 ISA Ringnode in the Token-Ring testing. On the client side, we tested performance using a Toshiba T4600 notebook system with a 486/33 processor, 4MB of RAM, and a 120MB hard disk. The Toshiba came to us with one proprietary 16-mm slot.

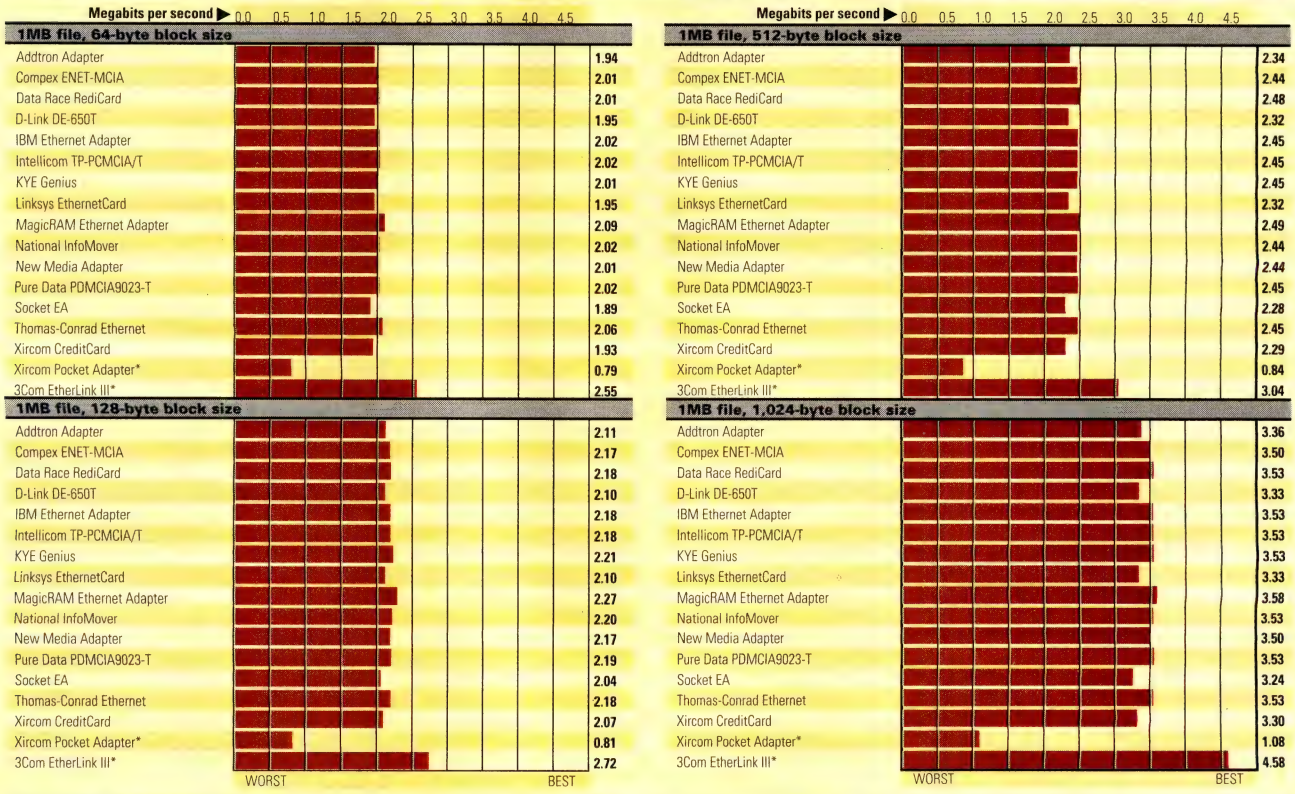
For comparison, we tested the Xircom Pocket Ethernet Adapter III (an external adapter). Because this adapter's performance is limited by the parallel port, it provided a good standard for comparison. We also used a 3Com EtherLink III ISA card as a high-end desktop adapter. Because Ethernet has a theoretical block-size limit of 1,518 bytes, most files larger than 1K split into smaller blocks. For an Ethernet standard of reference, we tested the external Xircom Pocket Adapter, both with a standard parallel port and with an Enhanced Parallel Port. Under Token-Ring, block sizes can be much larger—up to 17,997 bytes for a ring speed of 16 megabits per second.

Also, for comparison, we tested throughput under NetWare's burst mode on a sampling of LAN adapter cards. Burst mode increases throughput speeds by allowing multiple packets to be sent without an acknowledgement after each packet. In burst mode, eight packets are generally sent before each acknowledgement.

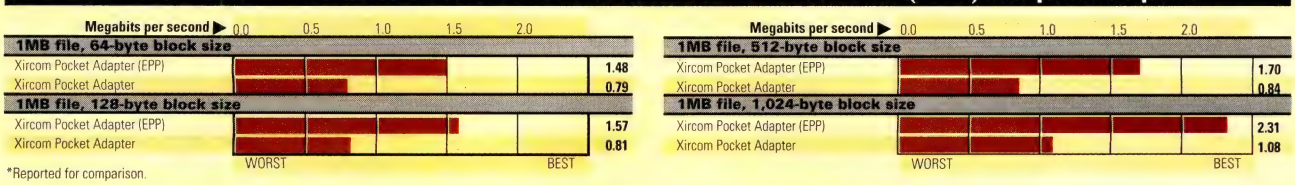
The **NIC Throughput** test from NetBench 2.1 evaluates the amount of data an adapter can transfer across the network in 1 second. A PC equipped with the adapter issues read requests to a file stored in a server's cache. The test uses block sizes ranging from 64 bytes to 4K. Results are reported in megabits per second.

NIC THROUGHPUT

ETHERNET ADAPTERS

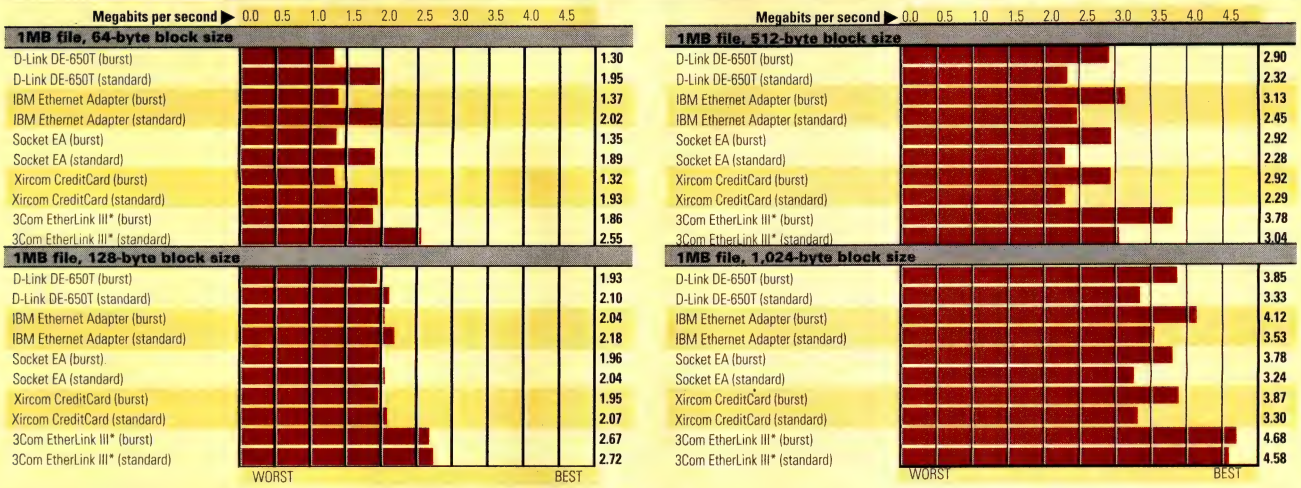


EXTERNAL ETHERNET ADAPTER*: Enhanced Parallel Port (EPP) vs. parallel port



*Reported for comparison.

ETHERNET ADAPTERS: burst mode vs. standard mode



TOKEN-RING ADAPTERS



TOKEN-RING ADAPTERS: burst mode vs. standard mode



How to Contact the Vendors

Here are the addresses and telephone and fax numbers for the vendors of products we reviewed in this roundup of PCMCIA LAN adapters.

Addtron Ethernet PCMCIA Adapter
Addtron Technology Co. Ltd., 1381 Kildaire Farms Rd., #331; Cary, NC 27511; 800-998-4638, 919-380-8999; fax, 919-380-8383.
List price: *$499.*
Circle 488 on reader service card

ENET-MCIA PCMCIA Ethernet Adapter
Compex Inc., 4055 E. La Palma Ave., Unit C, Anaheim, CA 92807; 800-279-8891, ext. 1071, 714-630-7302; fax, 714-630-6521.
List price: *$375.*
Circle 489 on reader service card

RediCard Ethernet Adapter RC-10BT
Data Race Inc, 11550 I-10, #395, San Antonio, TX 78230 800-749-7223, 210-558-1900; fax, 210-558-1929.
List price: *$399.*
Circle 490 on reader service card

D-Link DE-650T PCMCIA Ethernet Adapter
D-Link Systems Inc., 5 Musick, Irvine, CA 92718; 800-326-1688, 714-455-1688; fax, 714-455-2521.
List price: *$395.*
Circle 491 on reader service card

IBM Ethernet Credit Card Adapter
List price: *$269.*

PC MAGAZINE EDITORS' CHOICE

IBM Token Ring 16/4 Credit Card Adapter
List price: *$575.*
IBM Corp., Old Orchard Rd., Armonk, NY 10504; 800-426-3333, 914-765-1900.
Circle 492 on reader service card

TP-PCMCIA/T
Intellicom Inc, 20415 Nordhoff St., Chatsworth, CA 91311; 800-992-2882, 818-407-3900; fax, 818-882-2404.
List price: *$350.*
Circle 493 on reader service card

Genius LAN Model ME-3000
KYE International Corp., 2605 E. Cedar St., Ontario, CA 91761; 800-456-7593, 909-923-3510; fax, 909-923-1469.
List price: *$259.95.*
Circle 494 on reader service card

EthernetCard
Linksys, 16811A Millikan Ave., Irvine, CA 92714; 800-546-5797, 714-261-1288; fax, 714-261-8868.
List price: *$299.*
Circle 495 on reader service card

MagicRAM Ethernet Credit Card Adapter
List price: *$295.*
MagicRAM Token-Ring Credit Card Adapter
List price: *$595.*
MagicRAM Inc., 1850 Beverly Blvd., Los Angeles, CA 90057; 800-272-6242, 213-413-9999; fax, 213-413-0826.
Circle 496 on reader service card

PC MAGAZINE EDITORS' CHOICE

InfoMover NE4100 PCMCIA Ethernet Adapter
National Semiconductor Inc., 2900 Semiconductor Drive, P.O. Box 58090, Santa Clara, CA 95052-8090; 800-231-6072.
List price: *$249.*
Circle 497 on reader service card

New Media Ethernet LAN Adapter
New Media Corp., 15375 Barranca Pkwy., Bldg. B101, Irvine, CA 92718; 800-227-3748, 714-453-0100; fax, 714-453-0114.
List price: *$249.*
Circle 498 on reader service card

PDMCIA9023-T
List price: *$330.*
PDMCIA9025-4/16
List price: *$645.*
Pure Data Inc., 1740 S. I-35, #140, Carrollton, TX 75006 214-242-2040; fax, 214-242-9487.
Circle 499 on reader service card

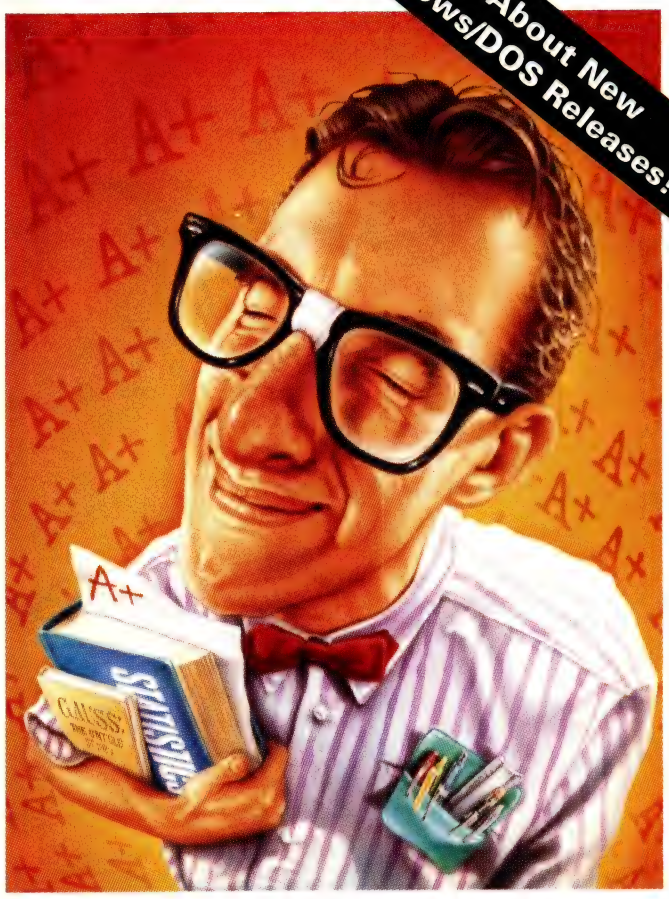
Socket EA
Socket Communications Inc., 2501 Technology Dr., Hayward, CA 94545; 800-552-3300, 510-670-0300; fax, 510-670-0333.
List price: *$399.*
Circle 500 on reader service card

TC-Card Ethernet 10Base-T PCMCIA Adapter
List price: *$359.*
TC-Card Token Ring 16/4Mbps PCMCIA Adapter
List price: *$779.*
Thomas-Conrad Corp., 1908-R Kramer Ln., Austin, TX 78758; 800-332-8683, 512-836-1935; fax, 512-836-2840.
Circle 501 on reader service card

CreditCard Ethernet Adapter
Xircom Inc., 26025 Mureau Rd., Calabasas, CA 91032; 800-438-9472, 415-274-8103; fax, 415-274-8113.
List price: *$349.*
Circle 502 on reader service card

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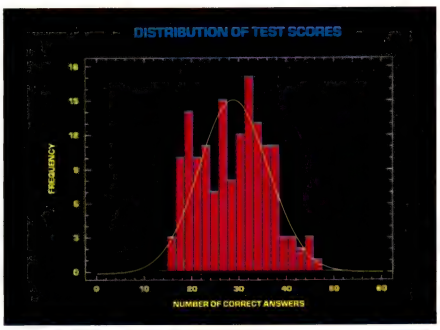


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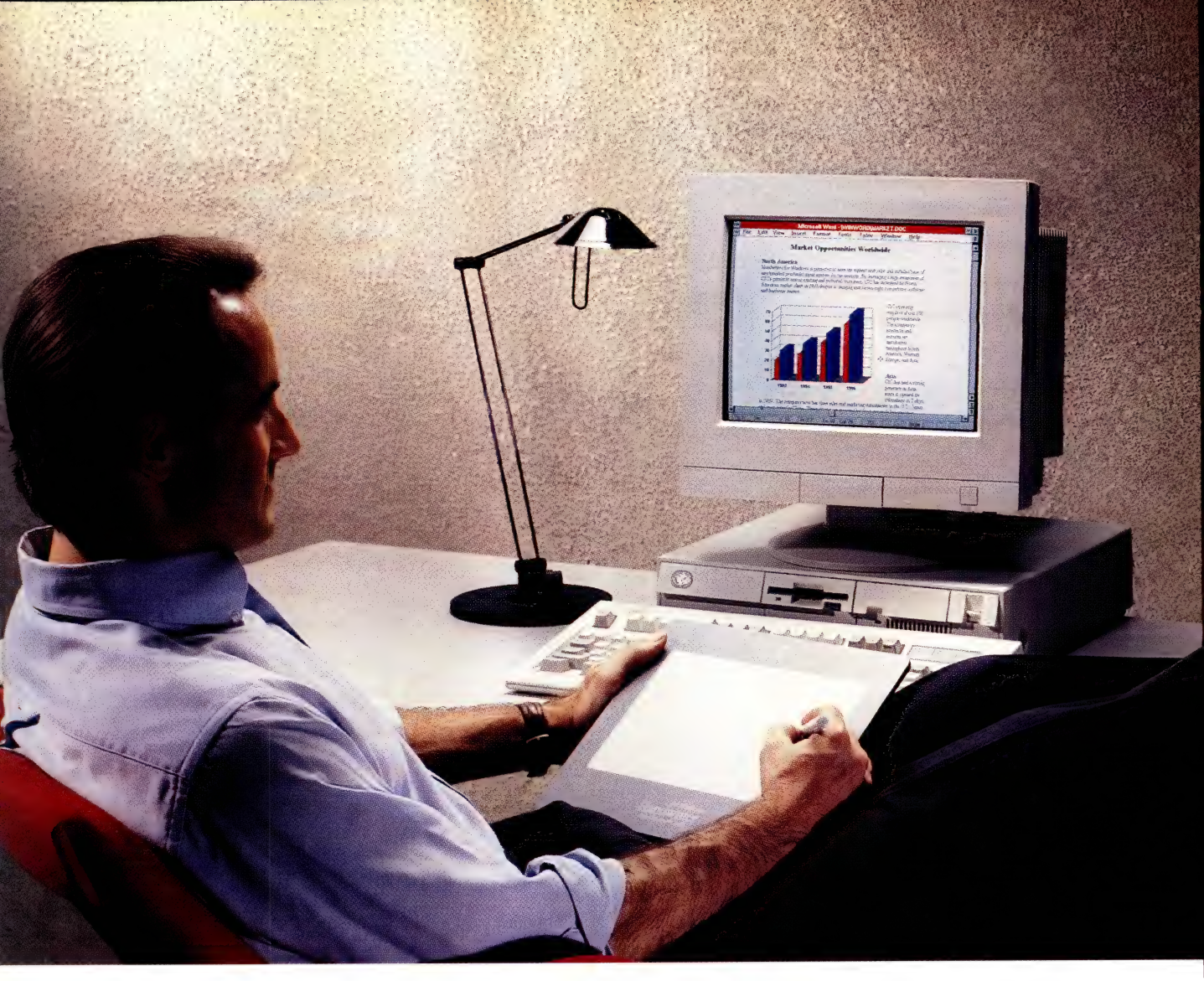
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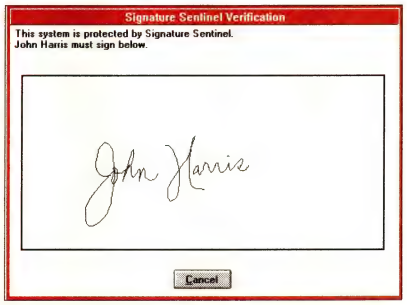


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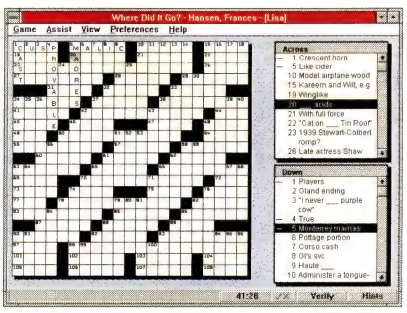
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▶ SUMMARY OF FEATURES

PCMCIA LAN Adapters

Products listed in alphabetical order by category ■ = YES ☐ = NO	ETHERNET ADAPTERS								
	Addtron Ethernet PCMCIA Adapter	**Compex ENET-MCIA PCMCIA Ethernet Adapter**	**Data Race RediCard Ethernet Adapter RC-10BT**	**D-Link DE-650T PCMCIA Ethernet Adapter**	**IBM Ethernet Credit Card Adapter**	**Intellicom TP-PCMCIA/T**	**KYE Genius LAN Model ME-3000**	**Linksys EthernetCard**	**MagicRAM Ethernet Credit Card Adapter**
List price	$499.00	$375.00	$399.00	$395.00	$269.00	$350.00	$259.95	$299.00	$295.00
Hardware Features									
Chip set manufacturer	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC
Version of PCMCIA standard	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Complies with ExCA	■	■	■	■	■	■	■	■	☐
Amount of buffer memory	16K	16K	16K	16K	16K	16K	16K	16K	16K
Power consumption:									
Typical (watts)	0.8	0.8	0.8	0.3	0.8	0.8	0.8	0.4	0.8
Maximum (watts)	1.6	1.2	1.2	0.5	1.2	1.2	1.2	0.5	1.2
Total traveling weight (ounces)	3.3	2.5	3.1	11.0	1.5	9.5	3.8	3.0	3.0
10Base2 coupler available	■	■	■	■	■	■	■	■	■
DB-9–to–RJ-45 converter included	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
Status lights:									
Activity/Collision	■■	■☐	■☐	■■	■☐	■☐	■☐	■■	■☐
Link/Power	■■	■☐	☐■	■■	■☐	■☐	■☐	■■	■☐
Location of status lights	Coupler	Coupler	Coupler	Coupler	Coupler	Coupler	Coupler	Coupler	Coupler
Locking connector	☐	■	■	☐	■	■	■	☐	■
Card sleeve included	☐	☐	☐	☐	■	☐	☐	☐	☐
Software Features									
Software manufacturer	D-Link	NSC/IBM	NSC/IBM	D-Link	NSC/IBM	NSC/IBM	NSC/IBM	Linksys	NSC/IBM
Can load driver high	☐	■	■	■	☐	■	■	☐	■
Compatible with NE2000 or other drivers	☐	☐	☐	☐	☐	☐	☐	☐	☐
Drivers included:									
NDIS	■	■	■	■	■	■	■	■	■
ODI	■	■	■	■	■	■	■	■	■
Packet	■	☐	☐	■	☐	☐	☐	■	☐
IBM CS/SS supported	☐	■	☐	☐	■	■	■	■	■
Phoenix CS/SS supported	■	■	■	■	■	■	■	■	■
SystemSoft CS/SS supported	■	■	■	■	■	☐	■	■	■
Toshiba CS/SS supported	☐	☐	☐	■	■	☐	☐	■	■
Installation program included	☐	☐	■	☐	■	■	■	☐	☐
Documentation Features									
Compatibility list	☐	■	■	☐	■	☐	■	☐	☐
Quick setup instructions	☐	■	■	☐	☐	☐	☐	☐	■
Technical support number listed	☐	■	■	■	☐	■	☐	■	■
Troubleshooting guide	☐	■	■	☐	■	■	■	■	■
Customer Support									
BBS	■	■	■	■	■	☐	■	■	☐
CompuServe forum	☐	☐	☐	☐	■	☐	☐	☐	☐
Free driver updates	■	■	■	■	■	■	■	■	■
Fax-back service	☐	☐	☐	☐	☐	☐	☐	☐	☐
Length of standard warranty	5 years	2 years	5 years	1 year	5 years	3 years	5 years	1 year	5 years
Technical support hours	11:00 A.M.–8:00 P.M. M–F	11:00 A.M.–8:00 P.M. M–F	9:30 A.M.–6:30 P.M. M–F	9:00 A.M.–9:00 P.M. M–F	24 hours, 7 days	11:30 A.M.–7:30 P.M. M–F	11:00 A.M.–8:00 P.M. M–F	10:00 A.M. – 7:30 P.M. M–F	12:00 noon – 9:00 P.M. M–F

N/A[1]—Not applicable: This feature is not relevant for Token-Ring networks. N/A[2]—Not applicable: This feature is not relevant for Ethernet networks. N/A[3]—Not applicable: The card is permanently connected to the cable.
NSC—National Semiconductor Inc., TC—Thomas-Conrad Corp.

	PC MAGAZINE EDITORS' CHOICE					PC MAGAZINE EDITORS' CHOICE			
						TOKEN-RING ADAPTERS			
	National Semiconductor InfoMover NE4100 PCMCIA Ethernet Adapter	**New Media Ethernet LAN Adapter**	**Pure Data PDMCIA9023-T**	**Socket Communications Socket EA**	**Thomas-Conrad TC-Card Ethernet 10Base-T PCMCIA Adapter**	**Xircom CreditCard Ethernet Adapter**	**IBM Token Ring 16/4 Credit Card Adapter**	**MagicRAM Token-Ring Credit Card Adapter**	**Pure Data PDMCIA9025-4/16**	**Thomas-Conrad TC-Card Token Ring 16/4Mbps PCMCIA Adapter**
Price	$249.00	$249.00	$330.00	$399.00	$359.00	$349.00	$575.00	$595.00	$645.00	$779.00
Controller	NSC	NSC	NSC	NSC	NSC	Fujitsu	NSC	NSC	NSC	NSC
Software driver	2.01	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Supports NDIS	■	■	■	■	□	■	■	□	■	□
Supports ODI	16K	64K	16K	64K	16K	32K	64K	64K	64K	64K
Size (inches)	0.5	0.6	0.8	0.7	0.8	0.7	0.8	1.1	0.8	1.1
Thickness (inches)	1.2	0.7	1.2	0.8	1.2	0.8	1.2	1.5	0.8	1.5
Weight (ounces)	2.4	2.2	3.0	5.0	1.5	0.85	1.5	3.5	3.0	1.5
Supports hot swapping	■	■	■	■	■	■	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Supports Card Services	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]	□	□	■	□
Supports 16-bit PCMCIA	■□	■□	■□	■□	■□	■□	□□	□□	■□	□□
Supports 32-bit PCMCIA	■□	■□	■□	■□	■□	■■	□□	□□	□□	□□
Connector	Coupler	Card	Coupler	Coupler	Coupler	Card	None	None	Coupler	None
Twisted-pair	■	□	■	N/A[3]	■	□	■	■	■	■
Thin coax	□	■	■	□	□	□	■	□	■	□
Software driver	NSC	NSC/New Media	Pure Data	Socket	IBM/TC	Xircom	IBM	IBM	IBM	IBM/TC
Supports NDIS	■	■	■	■	■	■	□	■	■	■
Supports ODI	□	□	■	■	□	□	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Supports Windows	■	■	■	■	■	■	■	■	■	■
Supports DOS	■	■	■	■	■	■	■	■	■	■
Supports OS/2	□	□	■	■	□	■	□	□	□	□
Supports NetWare	■	■	■	■	■	■	■	■	□	■
Supports Windows NT	■	■	■	■	■	■	■	■	■	■
Supports LANtastic	□	□	□	□	□	■	□	□	□	□
Supports Banyan VINES	■	■	■	■	□	□	■	□	■	□
Supports IBM LAN Server	■	□	■	■	□	□	□	□	■	□
Supports Microsoft LAN Manager	■	■	■	■	■	■	■	■	■	■
Supports Novell NetWare Lite	■	■	■	■	■	■	■	■	■	■
Supports Windows for Workgroups	■	■	■	■	■	■	■	■	■	■
Supports Windows 95	■	□	■	□	■	■	■	□	■	■
Supports Novell NetWare 4.0	■	■	■	■	■	■	■	□	■	■
Supports Windows 3.1	■	□	■	■	■	■	■	□	■	■
Supports Novell NetWare 3.12	■	■	■	■	■	■	■	■	■	■
Supports Novell NetWare 2.2	■	□	■	■	□	■	□	□	■	□
Warranty	Lifetime	Lifetime	5 years	2 years	5 years	2 years	5 years	5 years	5 years	5 years
Technical support	24 hours, 7 days	11:00 A.M.–9:00 P.M. M–F	8:00 A.M.–8:00 P.M. M–F	11:30 A.M.–8:30 P.M. M–F	24 hours, 7 days	9:30 A.M.–7:30 P.M. M–F	24 hours, 7 days	12:00 noon–9:00 P.M. M–F	8:00 A.M.–8:00 P.M. M–F	24 hours, 7 days

Practical Wireless

by O. Ryan Tabibian

You can't just roam around your office or your office campus with your notebook computer and stay attached to the network—even the simple wire from your LAN adapter becomes an annoyance or a restriction. So it's no surprise that wireless technology is quickly gaining popularity with mobile professionals, promising freedom from cords, cables, and sometimes-hard-to-find Ethernet connections.

Companies such as NCR Corp., Proxim, Pure Data, and Xircom are currently marketing or planning to market PCMCIA Type II wireless LAN adapters for use on notebook computers. But beware: Wireless LAN peripherals are still evolving rapidly, and there are many unanswered questions, including how the devices will work and what bandwidth they'll be allowed to use. If you can put off the decision to commit to a product or methodology, do it.

Ever since the Institute of Electrical and Electronics Engineers (IEEE) formed a committee to develop and publish standards for wireless LAN products in 1990, it has faced obstacles brought about by the wide variety of technologies used in radio-based computing. Other issues, including data security and interference, will need to be addressed in the IEEE committee's 802.11 standard. But recently the committee and its members have agreed to move toward a compromise in order to finalize a standard; a draft of the proposal is expected by the time you read this.

With the wireless LAN market edging closer to establishing a standard, more and more PCMCIA wireless LAN adapters are entering the market. Proxim, which has been the clear market leader in wireless LAN technology, has begun beta testing of its second-generation PCMCIA wireless LAN adapter, the RangeLAN/2. Other vendors, including National Semiconductor, NCR, Pure Data, and Xircom are also beginning to jump onto the wireless bandwagon.

Xircom and National both plan to release wireless PCMCIA products in the near future. Xircom's product, Netwave, is currently in beta testing and is due to ship by the first quarter of 1994.

Unlike vendors such as NCR and Pure Data, which use an antenna to connect to the card in the server, Netwave uses a scheme called the Extended Service Area (ESA). The ESA uses "access points"—Netwave adapters placed in strategic locations around the office and wired to the network—connected into clusters, with each access point covering an area about 50 meters across. Users can move from one access point to another without losing the connection to the server. Proxim plans to implement a similar technology in its RangeLAN/2.

Access-point technology is well suited for wireless LANs for two reasons. First, the PCMCIA card extends battery life by drawing less power, because the signal only needs to travel a maximum of 50 meters. And second, many servers are normally locked in closed rooms, a situation unsuitable for wireless antennas.

National, which has been the leader in PCMCIA Ethernet products, has signed an agreement with Traveling Software to develop and market a wireless product jointly. The first product—expected in the first quarter of 1994—will integrate hardware from National and software from Traveling Software.

YOU TAKE THE HIGH ROAD. . .

A wireless LAN adapter generally uses one of two technologies to transmit its signal: spread-spectrum radio or infrared. Wireless LAN vendors design their products to use spread-spectrum technology (a method for modulating radio frequency waves or data signals so that they occupy more of the RF band than is necessary to transmit information). Spread-spectrum radio is flexible and, perhaps most importantly, can penetrate many kinds of walls, although large amounts of metal can cause interference.



Proxim, which has been the market leader in wireless LAN technology, is already into beta testing of its second-generation adapter, the RangeLAN/2.

There are two different implementations of spread-spectrum technology: direct sequence and frequency hopping. Many market pioneers, such as Proxim, use direct sequence, in which the radio signal is spread over a specific portion of the RF band. With direct sequencing, data is transmitted simultaneously over a wide area of the frequency.

Frequency hopping is quickly gaining popularity with vendors. Here, the

radio signal "hops" across radio frequencies in a predefined pattern. Because the signal does not stay long in any one part of the band, interference and tampering become virtually impossible. Next to infrared, which cannot penetrate walls, frequency hopping is the most secure method of data transmission. Proxim plans to use this technique with its RangeLAN/2 product, which is due out in early 1994. NCR, Pure Data, and Xircom (which plans to release its new product sometime in 1994) also plan to use frequency-hopping technology.



Pure Data uses an antenna connected to the PCMCIA-format LAN adapter card to transmit. Another scheme, the Extended Service Area, uses access-point technology.

Other vendors, Photonics and Spectrix for instance, have opted to use infrared instead of spread-spectrum technology. Unlike spread-spectrum, infrared uses high-frequency light energy to send signals over the airwaves. These signals are transferred by line-of-sight only—they cannot penetrate walls or any other objects—and they are limited in transmission distance.

Despite the limitations, infrared technology does have two things going for it: low cost and high speed. It is the cheapest form of wireless communication, and it can match speeds of hard-wired networks. Infrared comes in two flavors, point-to-point and diffuse. Point-to-point transmission—the same technology that is used in your TV remote control—has limited range, and the devices (the transmitter and the receiver) must be situated in a straight line. In contrast, diffuse infrared does not require a straight-line connection because it bounces signals off either walls or other objects, but it is still by its inability to penetrate walls.

An infrared LAN is a feasible solution for a network that is constrained to a single room and requires a high level of security. Diffuse infrared would be appropriate for stock trading floors where security is paramount, or factory floors where RF interference can be a problem. In addition, infrared is immune to tampering and is not subject to government regulation.

Products that use spread-spectrum radio, on the other hand, have to share the electromagnetic spectrum with other wireless technologies. The government limits the power output of spread-spectrum devices to 1 watt, and does not require an end-user license if the device conforms to the specification. Both PCMCIA wireless LAN adapters that we looked at use between 150 and 250 milliwatts of power.

LIMITED BANDWIDTH

But establishing *how* a wireless LAN will work isn't the only problem. LAN adapter manufacturers also have to worry about *where* in the electromagnetic spectrum those transmissions will be allowed. And that assignment is up to the Federal Communications Commission (FCC).

In the United States, the FCC is responsible for assigning sections of the electromagnetic spectrum for use by different air-based technologies (See "Connecting Over the Airwaves," *PC Magazine*, August 1993). Currently much of the spectrum is assigned to TV and radio stations, cellular phones, ham radios, and military communications systems. A limited amount of unassigned space is available for use by wireless LANs.

The FCC has allocated three frequency bands for use by wireless air-based communications: 902 to 928 MHz, 2.4 to 2.483 GHz, and 5.72 to 5.85 GHz. Most commercially available products use the 902- to 928-MHz band, with a few moving to the 2.4- to 2.483-GHz band.

The 902- to 928-MHz band is referred to as the Industrial, Scientific, Medical (ISM) band. The ISM band is not regulated and—as it is used for car alarms, automatic vehicle-location systems, and microwave ovens—it is cluttered with traffic. The 2.4- to 2.483-GHz band currently *is* regulated and is used for wireless communications products.

Even with questions surrounding the lack of standards and the allowable bandwidth, wireless LANs can be suitable for users who need limited file transfer and electronic mail. Because wireless LAN adapters do not, in general, perform as well as their wired counterparts, they are not suitable for high-traffic applications, including client/server. If that's what your office needs, stick to a standard full-size or PCMCIA LAN adapter.

Wireless LAN technology holds a lot of promise for the future. Currently, however, with the lack of standards, the technology is constantly changing, and the process will continue until those standards are agreed upon. Until then, if you are planning to build your network around wireless technology, weigh your decisions carefully. Today wireless technology may be a feasible alternative for use with a small number of client PCs as a complement to an existing wired network.□

support. For the regular traveler, round-the-clock technical support might be at the top of the list.

INSTALLATION UPS AND DOWNS

We did find several differences between the products in these areas outside of performance and compatibility. Some of the cards in our test came with installation utilities that enhanced their appeal. Among them, National Semiconductor's InfoMover NE4100 PCMCIA Ethernet Adapter and the Socket EA each had easy-to-use installers and clear, well-written documentation. On the other hand, both Compex's ENET-MCIA PCMCIA Ethernet Adapter and Intellicom's TP-PCMCIA/T lacked software installers and had very poor documentation.

Two methods are used for installing PCMCIA network adapters. The most widely used method involves installing an *enabler,* a driver through which the host PC talks to the PCMCIA peripheral. Two types of enablers are in use, one of which executes from the CONFIG.SYS file, and another that can be run manually from the command prompt or placed into the AUTOEXEC.BAT file. The second method of installing PCMCIA network adapters uses the Card and Socket Services. Although this method has not yet gained widespread popularity, many vendors are now moving toward support for the services (see the Summary of Features).

Indeed, not every Ethernet adapter card was as easy to install as it should have been. Neither the D-Link DE-650T PCMCIA Ethernet Adapter nor the Thomas-Conrad TC-Card Ethernet 10Base-T PCMCIA Adapter had installation utilities, for example. We had to copy the drivers and edit the configuration files for each. D-Link didn't even include installation instructions in the manual, so we had to refer to the driver disk's README file. Thomas-Conrad did provide detailed written instructions.

Other products have friendlier installation programs. The Data Race RediCard Ethernet Adapter RC-10BT installs the drivers with little or no feedback to the user. In fact, after installation we were not sure where the drivers had been copied to and what changes were made to CONFIG.SYS. The installer for the IBM Ethernet Credit Card Adapter had some minor glitches: although it copied the enabler and edited CONFIG.SYS, it did not copy the correct ODI drivers to the hard disk (the manual helped, however). The New Media Adapter's installer was more impressive. It guides the user through every step of the installation, copying all the necessary drivers. Its manuals consisted of well-organized photocopies.

Installation of the National Semiconductor InfoMover was so simple that we didn't need to refer to its methodical documentation. National includes a resource-allocation utility that determines which I/O port and interrupts are available for use. The Pure Data PDMCIA9023-T's installer prompted us with information on how to set up for each network operating system, but after about six different prompts it only copied the enabler and edited CONFIG.SYS. We had to copy the ODI drivers manually. The installer does provide the tech support number at the end of the process.

Not every Ethernet adapter was as easy to install as it should have been. Some had no installation program; others had poorly organized documentation.

Installation of the Socket EA required no configuration by the user, thanks to an extensive installer that even asked us to choose the frame and cable type. The manual was well-organized and contained detailed, easy-to-understand material.

No installer was provided with the Xircom CreditCard—but fortunately installation was easy enough without it. Only two enablers that execute from the command prompt need to be copied, and no changes are made to the configuration files. The manuals and on-line documentation are orderly and descriptive.

We found that some vendors, including Intellicom and KYE International Corp., not only use the National/IBM card design but use National's installation utility as well. In the case of the KYE Genius LAN Model ME-3000, not only did the installer carry a National label, but the default install directory was \NSC. Intellicom did make some minor cosmetic changes to the installer, although it provided limited notebook support. The photocopied manual was not well organized.

Compex, which licenses its product from National/IBM, does little to distinguish its product from the rest of the pack. The Compex ENET-MCIA shipped to us did not have a label, and the manual consisted of some pages stapled together with "Copyright National Semiconductor" printed on every page. Even the bulletin board number that Compex provided is for the National BBS.

Although each Token-Ring card was designed and manufactured by IBM, there were other differences. The IBM Token-Ring 16/4 Credit Card Adapter and the Pure Data PDMCIA902-4/16 had the simplest installations, and each was similar to its Ethernet counterpart, including excellent documentation.

The other two products, the MagicRAM Token-Ring Credit Card Adapter and the Thomas-Conrad TC-Card Token-Ring 16/4Mbps PCMCIA Adapter, use the IBM drivers, but without an installer. We had to edit CONFIG.SYS ourselves, including typing in "RS=16" to adjust for the default ring speed of 4MB. Thomas-Conrad did provide a comprehensive manual; MagicRAM, on the other hand, sent us a copy of IBM's Token-Ring manual.

As the notebook and peripherals markets grow and change over the coming months with new products, standards, and specifications, the right choice may seem less clear each day. But if our testing of today's products is any indication, buyers who stick to the basic criteria of price and ease of use—and to widely adopted standards—still have some solid information upon which to base a sound purchase decision.□

Our Contributors: O. RYAN TABIBIAN is a senior technical specialist at ZD Labs, and coordinated testing for this article. ANDREW KANTOR is a staff editor and ADAM A. HICKS is an editorial researcher at *PC Magazine.* GAIL SHAFFER was the associate editor in charge of this story.

PC Tech

Today's applications are more powerful than ever, giving users the ability to increase productivity through customization. Our newest column, Extending Your Apps, will help you get the most from your applictions.

User-to-User

BY NEIL J. RUBENKING

Faking A Disk

I recently had difficulty trying to install some software on 720K disks onto a computer with only a 1.2MB floppy drive. I tried the usual trick of copying the files to 1.2MB disks on another machine and labeling them like the 720s. That didn't work because the install program for the software was sensitive to the media type it was installing from. Apparently the vendor used different file layouts depending on the kind of floppy disk the software was delivered on, and the install program could not find what it was looking for.

I then tried DRIVPARM and DRIVER.SYS to try and remap the 1.2MB drive as a 720K. That didn't work either. DRIVPARM and DRIVER.SYS don't accept a 720K mapping onto a 1.2MB drive.

The solution actually turned out to be rather simple. The key is recognizing that, while the 720K format has 9 sectors per track and the 1.2MB format has 15, *both* have 80 tracks. You just have to get a 1.2MB disk to "look" like a 720K from the point of view of the BIOS and the DISKCOPY utility.

Using DEBUG, I loaded the boot sector from a 720K disk and then wrote it to a 1.2MB disk. Now, the BIOS Parameter Block (BPB) on the 1.2MB disk looked like the BPB on the 720K disk. Then, I simply did a DISKCOPY from the vendor's 720K distribution disks to my fake 720K disks. All DISKCOPY does is copy tracks (determined by the BPB!), so it was happy because the BPBs matched on the disks. The BIOS was happy because it never knew what was being perpetrated; it read and wrote tracks as requested. DOS was happy because it saw a 720K BPB and thought the disks were genuine 720Ks. The install program was happy because, when it checked the media type on the fake disks, it found just what it was expecting. And I was happy because I'd worked around the problem and gotten the software exactly where I wanted it!

Two simple DEBUG commands can make a 1.2MB disk "look" like a 720K disk from the point of view of the BIOS and the DISKCOPY utility.

The trick works because the 1.2MB format includes enough tracks and sectors per track to accommodate a 720K format as a subset. There are just 6 wasted sectors per track to which neither the BIOS or DOS ever pay any attention.

I tried the same trick with a 360K disk and a 1.44MB disk to load some software onto a PS/2 that only had a single 1.44MB floppy drive, and this worked too—the 1.44MB disk could be made to "look" just like a 360K disk. And though I haven't tried it yet, you could probably make a 1.44MB disk look like a 1.2MB disk if you wanted to.

The DEBUG commands to load the boot sector from a disk in B: and write it to a disk in A: are

```
L 100 1 0 1
W 100 0 0 1
```

The only glitch I've discovered is in trying to read these mutant disks with OS/2. There are bugs in the OS/2 disk device driver that cause trash data to be read off these disks, though DOS reads them just fine.

Tony Ingenoso
Ft. Lauderdale, Florida

▶PC MAGAZINE: What an ingenious solution—I had to try it right away. Indeed, two simple DEBUG commands can make a 1.2MB disk "look" like a 720K disk. Be warned that immediately after you change the disk's BPB, it's in an unstable state. The files shown in its root directory aren't actually accessible, and CHKDSK shows the disk as totally trashed. FORMAT won't format the disk and retain the 720K apparent size. The only thing that works is using DISKCOPY to copy a legitimate 720K disk onto the fake 720K.

Luckily there aren't many install programs that insist on running from a particular size of disk. Still, if you should run across one, using this tip is a lot quicker than sending to the manufacturer for a set of different-sized disks!

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NUMSUB.ASM
Complete Listing

```
_dpt        PROC NEAR
            MOV CX, 10
dploop:
            XOR DX, DX
            DIV CX
            PUSH DX
            CMP AX, 0
            JE undo
            CALL dploop
undo:
            POP DX
pdig:
            ADD DL, 30H
            CMP DL, 39H             ;test for Hex digits
            JLE pch                 ;not required for radix <= 10
            ADD DL, 7               ;convert 9+1 to A
pch:
            MOV AH, 2
            INT 21H
            RET

_dpt        ENDP
```

Figure 1: **This compact assembly-language subroutine prints numbers in hex, decimal, octal, or binary.**

A Tiny Number Printing Routine

I've enjoyed reading your sample programs and utilities—they've taught me a lot about the peculiarities of the PC. Still, I get depressed at how little of what we learned about programming thirty years ago is remembered today. The printing of numbers is a simple example. The assembly language routine in Figure 1 prints decimal numbers. If you enter the routine at the label `dploop` with 16 (10h) in CX, it will print hex; with 8, it will print octal; with 2, binary. Call `pdig` with a small number in DL and it will be printed as a digit; call `pch` and you'll print a single character.

The number printing removes leading zeroes, except for the special case of 0. The only "magic" here is the use of the stack to store the remainders of successive divisions so that they can be unstacked and printed in proper order. They are not counted. The routine just calls itself recursively whenever there is a nonzero quotient and unwinds the calls to print each digit in turn. Since the routine can't escape without printing a digit, the zero case is handled automatically.

Eric Jensen
Bedford, New Hampshire

▶PC MAGAZINE: There was a time when even the most advanced computer had just a few kilobytes of memory, and every byte of code was required to do double and triple duty. With the advent of multimegabyte RAM boards, the need to pinch every byte has lessened, and programmers have indeed forgotten some of the old ways. Let ten programmers write an ASM program that outputs numbers and you'll get ten different algorithms, none as compact as the one shown in Figure 1.

Since the programs in this column are usually assembled with DEBUG, I converted the ASM routine to a standardized beginning for any DEBUG-assembled program that needs to print numbers. BASES.SCR in Figure 2 incorporates this standard beginning. The command `DEBUG < BASES.SCR` will create the program BASES.COM, which prints the number 65,535 in base 16 and then in every base from 10 down to 2. The `printOneBase` routine calls the `dploop` subroutine to print the current base itself in decimal and uses the `pch` subroutine to print a TAB. Then it calls `dploop` again to print 65,535 in the current base and uses `pch` twice to print a carriage return and line feed.

It's amazing how much power is packed into the 30 bytes at the start of this little program. I'm saving these number-printing routines for future use!

Download these files from PC MagNet archived as NUMPRN.ZIP. □

BASES.SCR
Complete Listing

```
A100
JMP 120         ; JMP begin
      ;=====================================
      ; begin number-printing subroutine
      ;=====================================
                ; dploop:
XOR DX,DX
DIV CX
PUSH DX
CMP AX,0
JE 10F          ; JE undo
CALL 102        ; CALL dploop
                ; undo:
POP DX
                ; pdig:
ADD DL,30
CMP DL,39
JLE 11B         ; JLE pch
ADD DL,7
                ; pch:
MOV AH,2
INT 21
RET
      ;=============================================
      ; end number-printing subroutines.
      ;=============================================
      ; Add code that will *use* the number-printing
      ; routine after this point.
      ;=============================================
      ;
      ; the remaining code prints 65,535 in hex
      ; and in every base from 10 down to 2
MOV CX,10       ; set up base 16
CALL 134        ; CALL printOneBase
MOV CX,0A       ; start with base 10
                ; loop:
CALL 134        ; CALL printOneBase
DEC CX          ; reduce base by 1
CMP CX,1
JA 129          ; JA loop:
INT 20
                ; printOneBase:
MOV AX,CX       ; put current base in AX
PUSH CX         ; save current base
MOV CX,0A       ; set for base 10
CALL 102        ; CALL dploop
MOV DL,09       ; put a TAB in DL
CALL 11B        ; CALL pch
POP CX          ; restore current base
MOV AX,FFFF
CALL 102        ; CALL dploop
MOV DL,0D       ; put carriage return in DL
CALL 11B        ; CALL pch
MOV DL,0A       ; put line feed in DL
CALL 11B        ; CALL pch
RET

RCX
54
N BASES.COM
W
Q
```

Figure 2: **This DEBUG script produces BASES.COM, which uses the number-printing subroutine to print 65,535 in ten different bases.**

Tutor

BY JEFF PROSISE

Sound Decisions For Your PC

In the past, if you wanted built-in sound capabilities on your computer, you had to buy something other than a PC compatible. The IBM PC was, after all, a serious business machine, and serious business users had no need for fancy sound hardware. That line of thinking is changing, as low-cost PC sound cards proliferate and more and more users discover the joys of PC audio. Today, a basic 8-bit sound board can be purchased for less than $100, and 16-bit boards capable of CD-quality sound for not much more.

If you ignore the relatively few PCs that come with audio hardware built in, and if you also ignore the ill-fated PC*jr*, which featured a four-voice Texas Instruments SN76496A sound chip, sound hardware on the PC comes in two different forms: On the low end, you have the PC's internal speaker and its associated circuitry. On the high end, you have add-in sound boards, such as Creative Labs' Sound Blaster 16 ASP and Turtle Beach's MultiSound. The gulf separating the two ends of the spectrum is a wide one indeed. On the one hand, you have a simple one-channel speaker circuit that is barely suitable for a toy, much less a desktop computer. On the other hand, you have sophisticated sound generation hardware that is a match for all but the most demanding audio needs. Here is a brief look at both sources of sound on the PC and at the technologies that make them work.

THE PC'S BUILT-IN SPEAKER The lowest common denominator for sound on the PC is the simple cone-shaped speaker built into virtually every system unit manufactured since the original IBM PC was introduced in 1981. At the lowest level, the speaker is controlled by varying the voltage of its input signal. A low to high voltage transition pulses the speaker cone outward, producing a sound wave, and a high to low voltage transition returns the cone to its relaxed state. By precisely timing the pulses so that the speaker cone oscillates at a certain frequency, a program controlling the speaker can produce audible tones. The frequency is the number of pulses, or speaker oscillations, per second, and is usually expressed in units of hertz (Hz) or kilohertz (kHz). One Hz is equal to 1 cycle per second, while 1 kHz is equal to 1,000 cycles per second. The average human is capable of hearing sounds ranging from about 20 Hz to 20 kHz.

The sound hardware featured on modern-day sound boards is light years beyond the simple speaker circuitry built into the PC.

Musical notes can be output from the PC's speaker by programming it to oscillate at certain fixed frequencies. For example, a tone whose unvarying frequency is 256 Hz corresponds to middle C. The trick lies in achieving that unvarying frequency. There are two ways to pulse the PC's speaker. The first and simpler of the two is to alternately write 1s and 0s to bit 1 of the I/O port at address 61h. To demonstrate, start DEBUG and type in the DEBUG script listed in Figure 1, which creates and runs a short assembly language program that repeatedly pulses the speaker in and out until a key is pressed. The frequency of the tone that is produced varies greatly from PC to PC, because the pulse frequency depends on how quickly the program executes. The tone will have a much higher pitch on a 486 than on, say, an old XT. Obviously, this method leaves much to be desired if the goal is to drive the speaker at a specified frequency.

The second method involves using output pulses from the PC's built-in timer chip to drive the speaker. Timer output is independent of CPU speed, so a timer-generated tone will sound roughly the same on all PCs (the tone's pitch and volume will vary somewhat because of variations in speaker design and construction). A PC's timer chip typically has either three or four independent channels numbered 0 to 2 or 0 to 3. Channel 2, referred to in some literature as *timer* 2, is the only channel whose output can be gated (or directed) to the speaker. Programming the timer to produce a tone on the speaker is a three-step process:

1. Program channel 2 of the timer chip to output square-wave pulses at the desired frequency. This is accomplished by writing the value B6h to port address 43h, the low byte of a divisor word to port address 42h, and the high byte of the divisor word to port address 42h, in that order. The *divisor word* is a 16-bit value that is divided into the timer's input clock frequency (1.193 MHz) to determine the output frequency. For example, C above middle C is produced by setting the divisor word to 2,330, because 1,193,180 divided by 2,330 is 512, the frequency of C one octave above middle C.

2. Enable the speaker—in effect, turn it on—by setting bit 1 of the byte at I/O address 61h to 1.

3. Gate the output from channel 2 of the timer chip to the speaker input. This is accomplished by setting bit 0 of the byte at I/O address 61h to 1.

Steps 2 and 3 can be combined into a single operation, since they involve setting bits at the same I/O address. The DEBUG script in Figure 2 programs the PC's speaker to sound a C until a key is pressed. Because the frequency is driven

DEBUG Script to Produce a Simple Speaker Tone

```
A 100
IN    AL,61          ;Read I/O port 61h
XOR   AL,02          ;Toggle bit 1
OUT   61,AL          ;Output the result
MOV   CX,800         ;Delay loop
LOOP  0109
PUSH  AX             ;Save AL
MOV   AH,01          ;Check the keyboard buffer
INT   16
POP   AX             ;Restore AL
JZ    0102           ;Loop back if buffer empty
RET                  ;Terminate

G
Q
```

Figure 1: **This DEBUG script drives the PC's internal speaker by alternately writing 1s and 0s to bit 1 of the byte at I/O address 61h. The tone's pitch depends on the speed of the PC.**

by the timer chip, not by the CPU speed, the note will sound approximately the same on every PC. You can alter the output frequency—and thus the pitch of the note—by changing the low byte and high byte of the divisor word. For example, changing the lines

```
MOV AL,E8
OUT 42,AL
MOV AL,08
OUT 42,AL
```

to read

```
MOV AL,D0
OUT 42,AL
MOV AL,11
OUT 42,AL
```

changes the frequency to 261.6 Hz, which corresponds roughly to middle C. Note that sound is cut off by clearing bits 0 and 1 of the byte at I/O address 61h.

We now know how to control the frequency of the note produced from the speaker, but we still lack a way to control the note's duration. The only interval timer other than timer 2 that is available on every PC is the periodic timer interrupt, which occurs every 55 milliseconds and is driven by channel 0 of the PC's timer chip. A program can revector this interrupt and use it as a counter. For example, a half-second tone could be generated by turning on the speaker, counting nine timer interrupts, and then turning off the speaker. The only problem is that the timer interrupt's 55 millisecond resolution (roughly $\frac{1}{18}$ second) is too grainy for accurate musical reproduction. BASIC's PLAY command works around this by reprogramming the timer to produce interrupts at four times the normal rate. If you wish to experiment with different sounds from your PC's built-in speaker, the PLAY command is a great vehicle for experimentation. The following command plays a tune similar to one featured in an arcade game that was popular in the early eighties:

```
PLAY "O3 MS L6D D MN L12G F D
 L6C P24 O1 L12G L6A L4A#"
```

(Note the letter O, for *octave,* not to be confused with the numeral 0.) The following command produces a sliding sound (or, as musicians refer to it, *glissando*) covering three octaves, a popular sound effect among game programmers:

```
PLAY "L64 O3 CDEFGAB O4 CDEFGAB
 O5 CDEFGAB"
```

As you work with the PLAY command, you'll discover that your PC's built-in sound hardware suffers from some rather severe limitations. For example, it has no volume control, and it is monophonic, not polyphonic. That's another way of saying that it can only play one note at a time. It's possible to play a C note, but impossible to play a C chord, which is composed of three simultaneous notes—C, E, and G.

ADD-IN SOUND BOARDS The sound hardware featured on modern-day sound boards is light years beyond the simple speaker circuitry built into the PC. In addition to supporting several simultaneous voices, today's sound boards use ASICs (application-specific integrated circuits) and DSP (digital signal processing) to produce rich, polyphonic sound. The sound boards also feature interval timers with resolutions measured in microseconds instead of milliseconds. Most boards support 8-, 12-, or 16-bit digital waveform audio, in which a waveform is stored as a series of *y*-values running along an *x*-axis representing time. The greater the number of bits and the higher the sampling rate (typical sampling rates are 11.025, 22.05, and 44.1 kHz), the greater the sound quality. Figure 3 illustrates why more bits and higher sampling rates yield better sound reproduction. The diagram on the left shows how an analog waveform is approximated with

DEBUG Script to Sound a Note on the PC's Speaker

```
A 100
MOV AL,B6          ;Set the timer mode and divisor format
OUT 43,AL
MOV AL,1A          ;Output the low byte of the divisor word
OUT 42,AL
MOV AL,09          ;Output the high byte of the divisor word
OUT 42,AL
IN  AL,61           ;Turn the speaker on by
OR  AL,03           ;  setting bits 0 and 1 of
OUT 61,AL          ;  I/O port 61h to 1
MOV AH,01          ;See if a key has been pressed
INT 16
JZ  0112            ;Loop back if not
IN  AL,61           ;Turn the speaker off by
AND AL,FC          ;  setting bits 0 and 1 of
OUT 61,AL          ;  I/O port 61h to 0
RET                ;Terminate

G
Q
```

Figure 2: **This DEBUG script programs the PC's built-in timer to oscillate at 512 Hz and gates the timer output to the speaker. The result is a C note whose pitch is independent of the speed of the host PC.**

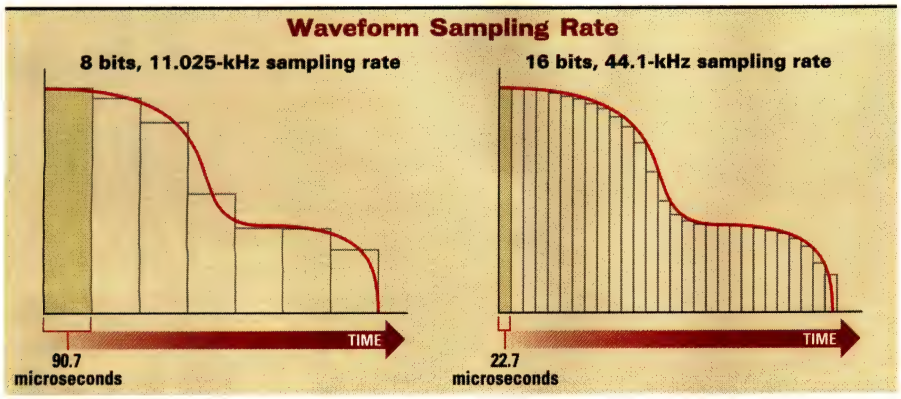


Figure 3: **The quality of sound output from digital waveform audio depends on the number of bits used to represent data and the sampling rate. Fewer bits and a lower sampling rate (left) produce a less accurate approximation of an analog waveform than more bits and a higher sampling rate (right).**

blocks representing an 8-bit, 11.025-kHz sample. The diagram on the right shows the same waveform approximated with a 16-bit, 44.1-kHz sample. Clearly, the latter of these two digital representations, which has 4 times the horizontal resolution and 256 times the vertical resolution of the former, more closely approximates the original wave. A low-end, 8-bit, 11.025-kHz board might suffice if your only use for it is to add sound to your favorite games, but true CD-quality sound demands 16 bits and a 44.1-kHz sampling frequency.

Many sound boards also support MIDI (Musical Instrument Digital Interface). MIDI is a protocol that allows a computer to control a musical device. A MIDI file is little more than a set of digital instructions telling a MIDI device what to play, when to play it, and what instrument to play it with. Because of this, MIDI files are considerably smaller than .WAV files, which must bitmap complex sound waves. A MIDI file that plays a violin sound for a second would only need to be about 30 bytes, whereas a .WAV file for the same sound output would be closer to 30,000 bytes.

One determinant of the quality of MIDI output is how good the MIDI device is at simulating the sounds produced by actual acoustic instruments—pianos, guitars, trumpets, and so on. The majority of PC MIDI boards simulate instrument timbres using a technique called *FM synthesis,* which uses layered sine waves to generate an output waveform. Most FM synthesis boards use either the two-operator Yamaha OPL2 sound chip or the four-operator Yamaha OPL3. In the parlance of MIDI users, an *operator* is a sine wave; two-operator boards use two sine waves to shape the output signal, while four-operator boards use four. All else being equal, a four-operator board produces better synthesized sound than a two-operator board.

The best MIDI boards don't use FM synthesis at all. Instead, they use a technique called *wavetable lookup,* producing sounds using digitized samples taken from real instruments. The samples are stored in ROM or loaded into adapter RAM from the hard disk. Boards that use this technique produce sounds that are close to those of actual acoustic instruments.

Understandably, the complexity of these sound boards means that programming them is no easy undertaking. The programmer's guide for the Sound Blaster, Sound Blaster Pro, and Sound Blaster 16 ASP is more than 500 pages long, and could easily stand to be 500 pages longer. A better way to program any of these boards is to use a third-party sound library that offers a common high-level interface to and drivers for a variety of boards. And if you're programming in Windows, Media Control Interface (MCI) is the way to go.

ASK THE TUTOR If there is a hardware or software topic that you would like to see explained in a future Tutor column, please send your suggestion to Tutor, *PC Magazine,* One Park Ave., New York, NY 10016-5802; or you can post it in the Tutor section of PC MagNet's Utilities/Tips Forum. □

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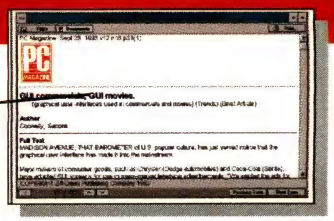
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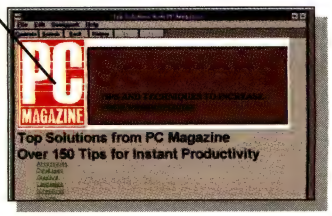
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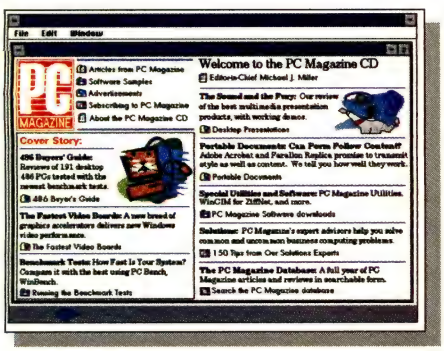




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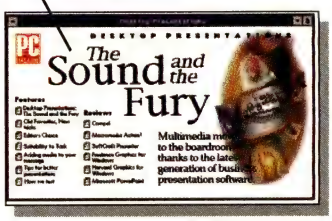


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Extending Your Apps

BY VINCENT CHEN

Accessing DLL Data Structures From WordBasic

It shouldn't surprise anyone to learn that shrink-wrapped applications are more powerful than ever before—giving users and developers alike tremendous opportunities to increase productivity through customization. In this issue, we inaugurate a new column called Extending Your Apps that reflects the sophistication of applications that contain powerful application development environments in their own right. In this space, we'll cover a wide variety of topics that will let you extend your own apps—DDE, OLE, REXX, WordBasic, VBA, OpenDoc—a veritable alphabet soup of techniques to get the most from your applications. First, we'll show you how to extend WordBasic's power programming language to use Windows' Common Dialog dynamic link library (DLL) file.

Windows programming isn't just for C and PASCAL programmers anymore. If you're a Word for Windows 2.0 user, you've already got a powerful programming language called WordBasic built right into your word processor. You can use WordBasic to customize virtually every aspect of Word for Windows: building new commands, replacing built-in functions, and interacting with users through custom dialog boxes. You can even use it to tap directly into and control Windows' basic services by accessing Windows DLLs.

A dynamic link library is just a collection of named functions and subroutines that provides certain services to Windows applications. They are called dynamic because they are brought into Windows only when an application requests a service and unloaded when they are no longer needed. Windows and Windows applications use DLLs extensively to share functions and manage memory resources. In fact, most of Windows itself is actually contained within three dynamic link library files: USER, KERNEL, and Graphics Device Interface (GDI), which collectively form the Windows application programming interface (API).

Accessing DLLs lets you perform a lot of useful operations that ordinary WordBasic commands can't handle, such as determining whether another application is running, finding the screen resolution, getting the DOS environment string, or even deciding if Program Manager is your default shell. Other examples of operations can be found in PSS.DOC, a sample file that comes with Word for Windows. Conspicuous by their absence from PSS.DOC, however, are WordBasic examples that use the functions in Windows 3.1's Common Dialog DLL (COMMDLG.DLL). This dynamic link library is responsible for helping Windows and Windows applications to present a common, familiar user interface; it provides standard dialog boxes for such fundamental interface operations as file selection, font selection, color selection, search-and-replace, and printer control.

Unfortunately for WordBasic programmers, COMMDLG relies on data structures, which are programming constructs used by advanced programming languages to group related variables into a single block of memory. In languages such as C, Pascal, and Microsoft Visual Basic, the declaration of a data structure provides a full listing of the members (or variables) located within a memory block and their data types. This declaration lets you access each member simply by using its name, and the programming environment uses the declaration listing to figure out where that member is located in the memory block.

WordBasic and most other application macro languages don't know how to work with data structures. But we don't have to let this limitation stop us. All we need to do is find a way to allow WordBasic to access individual members of a data structure, either to set it to a value or to return its value to WordBasic. Our DLL ACCES.DLL helper DLL (which you can download from PC MagNet, along with the sample macros from this article) provides the solution to this problem; it is WordBasic's gateway to the members of the data structure.

Here we inaugurate a new column that reflects the sophistication of applications that contain powerful application development environments.

Combine this with a few WordBasic convenience routines that help WordBasic reserve a memory block of the correct size, add a few organizational concepts, and you'll be able to use almost any DLL functions that require data structures. I'll illustrate the use of these routines and concepts by means of a few sample macros that use the COMMDLG interface to enhance Word for Windows' FileOpen and FileSaveAs commands. But you can use similar techniques with any programming environment that can use DLLs; a category that includes the macro languages from Ami Pro, Micro-

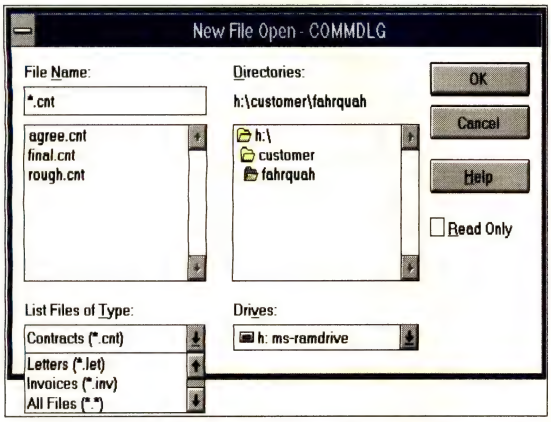


Figure 1: **Use Windows' COMMDLG.DLL to replace WinWord's default File Open dialog box. By creating your own File Open dialog box, you can get around WinWord's file mask limitations.**

soft Excel, and even personal information managers such as PackRat!

WHY REPLACE FILEOPEN? One of Word for Windows' most serious file-handling deficiencies is its inability to start the FileOpen dialog box with a filespec pattern other than the default patterns of *.DOC (for Word files), *.DOT (for Word template files), *.RTF (for rich text format files), or *.TXT (for text files). As a direct result of this, many people simply use the .DOC extension, keeping track of the type of document using subdirectories or the first eight characters of the filename. Life would be much simpler, however, if you could use the file extension in order to categorize your documents by type. Imagine if all your contracts were named *.CNT, letters *.LET, invoices *.INV, and so on, and if you could include these extensions in the pattern list box in your file-selection dialog boxes, as shown in Figure 1.

Although you can build custom dialog boxes in WordBasic, the FileOpen dialog box is a bit more complex to manage, because it needs to access the file system to build up its lists of drives, directories, and filenames. The default WinWord FileOpen dialog box does this by using built-in file-selection dialog boxes, but you can use the prebuilt dialog boxes supplied by COMMDLG.DLL. With this DLL file, all you have to do is provide some details, such as what directory to use, what type of files to display, and what the title bar should say.

The COMMDLG interface functions are designed to be flexible, providing a wide range of options to satisfy the needs of a great variety of possible Windows applications. Rather than using separate function arguments for the different options, each COMMDLG function uses a single argument, which represents a data structure that packages all the options and all the function results into a single, functional unit. Provided that both the calling program and the COMMDLG function are in agreement on the definition of a data structure, you can access this unit in a consistent manner.

Normally, the procedure for doing this is relatively straightforward. Before calling the COMMDLG function, the calling program creates the data structure and sets some or all the members of the data structure for use as input to the function. And before returning, the COMMDLG function sets some or all the member variables to return results to the caller.

Since WordBasic has no concept of data structures, it can't be used to access these COMMDLG functions directly. But luckily, these and most other DLL functions use only the addresses—or memory locations—of data structures as function arguments. These addresses are represented as long integers. (This is commonly known as *pass by reference*—when the address, not the actual value, of a variable is given to the function.) A WordBasic macro, therefore, can access these functions indirectly by declaring a data structure as type Long then using the structure's address to locate its members.

Once WordBasic locates the data member, it just needs a bit of help interpreting the data that's there. That's where DLLACCES.DLL comes in. DLLACCES is a custom collection of functions that translates data at specified memory locations to and from data types that WordBasic understands: integer, long, double, and string. In essence, you can tell DLLACCES to do something like "get me the long integer value of the second data member of this structure," or "set the fifth data member of this structure to the byte value 16, but I'm passing you an integer (since WordBasic does not have a Byte type)."

To use the DLLACCES.DLL functions, you need some understanding of how data structures are stored in memory. Figure 2 shows a memory block containing the data structure called MyStruct, whose C-language definition is to the left in the figure. This data structure contains five members: one long integer, two integers, one string, and one double-precision number. The rectangular blocks represent the memory each variable occupies. The first variable—a long integer—uses 4 bytes, the next two—both integers—use 2 bytes each, var4—the string—uses 4 bytes, and the double-precision variable uses 8 bytes.

The total size of the structure is 20 bytes. Thus, in order to find the location of any variable in the structure from the beginning of its memory block, just add up the sizes, in bytes, of all the variables that come before it. That's what the labels to the left of each block represent: the offset of each variable from the beginning of the structure. A programming environment that supports data structures

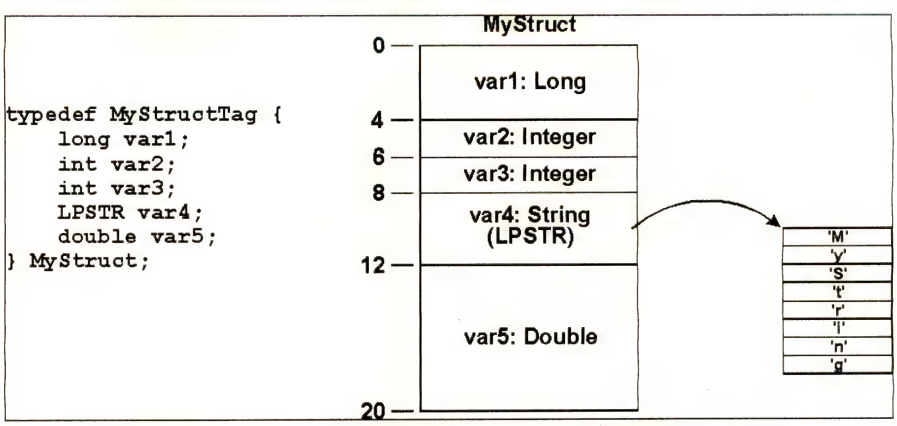


Figure 2: **The C-language definition (left) for the MyStruct data structure (right).**

can automatically calculate the offset for each data member and convert the bytes located there to the value of the correct data type. But WordBasic can't do this, so you must calculate the memory offset of each data member manually, and then use the DLLACCES functions to convert the data into a form that WordBasic can handle.

THE DLLACCES.DLL FILE Let's take a look at some examples of how to use the DLLACCES functions with the sample data structure MyStruct, shown in Figure 2. The assigning of values to bytes, long integers, floating-point numbers, double-precision numbers, and string variables in WordBasic is accomplished by means of a series of DA_Set functions. (The exact syntax of which you'll find in DLLACCES.DOC, which documents the entire suite of DLLACCES functions and gives detailed instructions for calculating these address offsets.)

Say, for instance, that you have the memory location of a MyStruct data structure stored in a variable called lpStruct, and you want to set its third member (var3) to the value 48. Since this value is an integer value, you'd use the DLLACCES function that sets integer variables (DA_SetInt), providing the function with the memory location of the data structure, the offset of the data member you're interested in (in this case, 6 bytes), and the value you want to assign to the data member:

```
var3Offset = 6
result = DA_SetInt(lpStruct,
 var3Offset, 48)
```

The result of the function is a status flag indicating whether the attempt to set the value of the variable has succeeded or failed. Note that you don't really need to use var3Offset (which stores the offset location of var3) to call the DA_SetInt function. But using variables to represent the offset values can help you document the members of a data structure in your code and make your code more readable.

DLLACCES also offers a similar set of DA_Get functions to help you retrieve the values of data members. For example, to get the value of var1 (a long integer), you would use DA_GetLong. Again, you supply the address of the data structure and the offset of the data member (0 in this case, since var1 is the first member of the data structure):

```
var1Offset = 0
var1Value = DA_GetLong(lpStruct,
 var1Offset)
```

DA_GetLong locates the data member, translates the data at the memory location to a long integer, and places the value in var1Value.

Accessing a string member in a data structure is just as easy, but it's worth a brief discussion. As the example in Figure 2 suggests, the data in the var4 data member is really only the address of a string: The actual character data is stored outside the data structure. This format allows the string to be of any length without requiring you to reserve space in the structure itself. Fortunately, WordBasic strings also work in this manner: They use the addresses of the actual data. Thus, getting the string value of the var4 data member is as simple as getting the values of other members:

```
var4Offset = 8
var4Val$ = DA_GetString$(lpStruct,
 var4Offset)
```

One thing to be aware of is that many DLL functions return string results in the data structure, but the functions do not allocate memory for the strings themselves. Rather, the functions expect the calling routine to reserve memory buffers for each string and to assign the memory address of each buffer to the appropriate data member of the structure.

Before we continue, a note of caution is in order. Accessing DLLs makes WordBasic both powerful and dangerous. Any actions you initiate through a DLL take place outside the normal error-trapping facilities of the WordBasic environment. If you use the DLL incorrectly, you can easily crash Windows. So save your work often, and to prevent losing any changes, always save your work before you test your macro. And once your program is debugged, test it out on several different Windows machines before releasing it to other users.

ORGANIZING THE MACROS We can make the whole process of creating and manipulating data structures much easier by combining the setting up of data structures the DLL calls into a single WordBasic interface function. In fact, it is often handy to combine such interface functions and other necessary routines into a

OPENFILENAME Data Structure

Complete Listing

```
C-Declaration of OPENFILENAME data structure:        WordBasic definition of
                                                              address offsets:

typedef struct tagOPENFILENAME { /* ofn */          '** Type OPENFILENAME ****
    DWORD      lStructSize;              /* (4) */       lStructSizeOff = 0
    HWND       hwndOwner;                /* (2) */       hwndOwnerOff = 4
    HINSTANCE  hInstance;                /* (2) */       hInstanceOff = 6
    LPCSTR     lpstrFilter;              /* (4) */       lpstrFilterOff = 8
    LPSTR      lpstrCustomFilter;        /* (4) */       lpstrCustomFilterOff =
12
    DWORD      nMaxCustFilter;           /* (4) */       nMaxCustFilterOff = 16
    DWORD      nFilterIndex;             /* (4) */       nFilterIndexOff = 20
    LPSTR      lpstrFile;                /* (4) */       lpstrFileOff = 24
    DWORD      nMaxFile;                 /* (4) */       nMaxFileOff = 28
    LPSTR      lpstrFileTitle;           /* (4) */       lpstrFileTitleOff = 32
    DWORD      nMaxFileTitle;            /* (4) */       nMaxFileTitleOff = 36
    LPCSTR     lpstrInitialDir;          /* (4) */       lpstrInitialDirOff = 40
    LPCSTR     lpstrTitle;               /* (4) */       lpstrTitleOff = 44
    DWORD      Flags;                    /* (4) */       FlagsOff = 48
    UINT       nFileOffset;              /* (2) */       nFileOffsetOff = 52
    UINT       nFileExtension;           /* (2) */       nFileExtensionOff = 54
    LPCSTR     lpstrDefExt;              /* (4) */       lpstrDefExtOff = 56
    LPARAM     lCustData;                /* (4) */       lCustDataOff = 60
    UINT       (CALLBACK* lpfnHook) (HWND, UINT,          callbackOff = 64
                  WPARAM, LPARAM);       /* (4) */       lpTemplateNameOff = 68
    LPCSTR     lpTemplateName;          /*(4) */      '** End Type **************
**************
} OPENFILENAME;
```

Figure 3: **C-language definition of the OPENFILENAME data structure.**

Initializing OPENFILENAME

Partial Listing

```
'**** 4. Initialize member variables used for INPUT *********

        '******** Set the structure size and window ID *********

        r = DA_SetLong(lpStruct, lStructSizeOff, lStructSize)
        hWnd = GetActiveWindow ' Call Windows API
        r = DA_SetInt(lpStruct, hwndOwnerOff, hWnd)

        '** Set the filter string, using the first one as  the default  **
        hstrFilter = 0 : lpstr = BuildLPString(filt$, hstrFilter)

        r = DA_SetLong(lpStruct, lpstrFilterOff, lpstr)
        r = DA_SetLong(lpStruct, nFilterIndexOff, 1)

        '**** 4a. Allocate global memory for file and file title ****
        '****     strings. Also used as return buffer, so allocate **
        '****     large enough space to hold return value.  *********

        hstrFile = 0 : lpstrFile = BuildLPString(fname$ + \
                String$(256, 0), hstrFile)
        r = DA_SetLong(lpStruct, lpstrFileOff, lpstrFile)
        r = DA_SetLong(lpStruct, nMaxFileOff, 256)

        hstrFileTitle = 0 : lpstrFileTitle = BuildLPString(\
                String$(256, 0), hstrFileTitle)
        r = DA_SetLong(lpStruct, lpstrFileTitleOff, lpstrFileTitle)
        r = DA_SetLong(lpStruct, nMaxFileTitleOff, 256)

        '**** 4a. Allocate global memory for the Default directory ****
        hDir = 0 : lpDir = BuildLPString(dir$, hDir)
        r = DA_SetLong(lpStruct, lpstrInitialDirOff, lpDir)

        '**** 4a. Allocate global memory for the Dialog box title *****
        hTitle = 0 : lpTitle = BuildLPString(title$, hTitle)
        r = DA_SetLong(lpStruct, lpstrTitleOff, lpTitle)

        '********** Set the Flags ************************
        r = DA_SetLong(lpStruct, FlagsOff, flags)
```



Figure 4: **Code to initialize the member elements of the OPENFILENAME structure.**

single macro library, which in WordBasic terms is simply a macro whose sole purpose is to supply routines for use by other macros. By putting common routines into a macro library, you allow one or more macros to use the routines without having to copy them over and over.

The new capabilities that we want to add to the FileOpen and FileSaveAs dialog boxes are organized into three macros. CommLib is a macro library containing the GetFileDlg$ interface function, which is responsible for doing all the work in calling COMMDLG file-selection functions, plus a few convenience routines for handling memory allocation. The other two macros, NewFileOpen and NewFileSaveAs, are simply replacements for WordBasic's FileOpen and FileSaveAs commands, respectively. Both of these macros are relatively simple, because they rely heavily on the functions in the CommLib macro library.

GetFileDlg$ is the most important function in CommLib. This function's role is to make COMMDLG's GetOpenFileName, GetSaveFileName, and the data structure they both use—OPENFILENAME—easier for us to use. By calling the GetFileDlg$ interface function, macros do not need to be aware of the messy details of the COMMDLG functions—they only need to pass a few standard WordBasic strings and numbers to GetFileDlg$.

The syntax for using GetFileDlg$ from other macros is

```
fname$ = CommLib.GetFileDlg$
(OpenOrSave, dir$, fname$,
 filt$, title$, flags)
```

Note that you use the MacroName.FunctionName (arguments. . .) calling syntax to call GetFileDlg$ from a macro outside the CommLib macro library. OpenOrSave indicates which of the COMMDLG functions to use: 0 for GetOpenFileName and 1 for GetSaveFileName. The rest of the arguments let you access a few of the many members of the OPENFILENAME data structure. In this particular example, you choose the starting directory (dir$), the required filename (fname$), the filespec filter (filt$), the title-bar caption (title$), and the flags that refine the behavior of the file-selection dialog box (flags). The return value fname$ either contains the full pathname of the file that the user selected or else contains an empty string indicating that the user has clicked on the Cancel button.

Supplying the starting directory and filename to the function is a rather straightforward process, but setting up the file-type filter string and defining the flags can be a bit tricky. Each file type is described by two components: the description and the file pattern. To build the filter string, you need to concatenate all the component pairs, separating each component with the pipe character (¦). Then store the resultant string in global memory using BuildLPString—one of the convenience routines in the CommLib macro library. COMMDLG uses the ASCII NUL (0) character as a separator for the filter string, but BuildLPString translates the pipe characters to NUL characters before storing the string in global memory.

The file types used for the File Open dialog box in Figure 1, for instance, are Contracts (*.cnt), Letters (*.let), Invoices (*.inv), and All Files (*.*). These result in the filter string

```
filt$ = "Contracts (*.cnt)¦*.cnt
¦Letters (*.let)¦*.let¦Invoices
 (*.inv)¦*.inv¦All Files (*.*)¦*.*"
```

The flags argument refines the behavior of the file-selection dialog boxes. For example, if you set the OFN_FILEMUSTEXIST flag, COMMDLG will pop up a warning if the user selects an invalid filename. You can use other flags in order to prevent the changing of directories, prevent the selection of existing files, and even allow selection of multiple files. Each flag is represented by a numeric value, which you must define in your WordBasic code.

Some of the more useful flags are

```
OFN_READONLY = 1
OFN_OVERWRITEPROTECT = 2
OFN_NOCHANGEDIR = 8
OFN_SHOWHELP = 16
OFN_MULTISELECT = 512
OFN_PATHMUSTEXIST = 2048
OFN_FILEMUSTEXIST = 4096
```

To use several flags at the same time, just add the values together. Our NewFileOpen macro, for instance, uses

```
flags = OFN_PATHMUSTEXIST +
 OFN_FILENMUSTEXIST
```

to force the user to choose a file that already exists.

GETFILEDLG$ IN DETAIL Although GetFileDlg$ specifically deals with accessing the GetOpenFileName and GetSaveFileName functions of COMMDLG, the procedure it uses is applicable whenever you deal with data structures and DLLs. The full code listing of the GetFileDlg$ and the other functions in the CommLib macro library is in DLLACCES.DOC, and the following discussion will attempt to give you an overview.

If you intend to take advantage of DLL functions, your first step in the WordBasic macro is to declare those DLL functions used by the routines (functions and subroutines) in the WordBasic macro. In the case of CommLib macro library, GetFileDlg$ uses functions in the DLLACCES library and the COMMDLG library (GetOpenFileName and GetSaveFileName). Windows API functions and DLL functions are generally described in C or Visual Basic, but it's not too hard to translate them into WordBasic. The WordBasic declaration for the GetOpenFileName function, for instance, is

```
Declare Function GetOpenFileName
 Lib "COMMDLG.DLL" (lpofn As Long)
 As Integer
```

This tells WordBasic that GetOpenFileName is a function in the COMMDLG.DLL DLL library, that it returns an integer, and that it takes a single long integer argument, which represents the address of an OPENFILENAME data structure. In general, any argument that is the address of a data structure must be declared as a long integer. You'll use this long integer in conjunction with the DLLACCES.DLL functions to access the individual members of the data structure.

Though not strictly necessary, defining each member variable's address offset at the head of the interface routine is also a good idea. By doing this, we not only document the data structure, but we also make the code more readable when the time comes to set and retrieve the values of the members. To determine the offsets, take a look at the documentation for the OPENFILENAME data structure shown in Figure 3. The size (in bytes) of each variable is noted in parentheses after its name.

The final preparatory step is to allocate a memory block of the proper size to accommodate those members of the COMMDLG data structure that we plan to use in our macros. Though it is possible to create a variable of arbitrary size within WordBasic itself (by defining it as a string variable), the program sometimes behaves strangely if you directly manipulate this memory in an attempt to make it look like a data structure. Therefore, you're much better off managing memory yourself by using Windows global memory (memory that is available to all Windows applications) for your data structures.

Working with global memory requires the use of Windows API functions, but I've written a number of convenience routines (which won't be described in too much detail here for reasons of space) to help your macros interface with these functions. The AllocVariable convenience routine lets you reserve a global-memory block of the size (in bytes) that you request, BuildLPString allocates global memory for individual string members of data structures, and FreeVariable releases the global memory allocated by both functions. All are stored in the CommLib macro library along with GetFileDlg$.

Replacement for FILEOPEN Macro

Complete Listing

```
' Name: NewFileOpen
' Description:
'    Example replacement for FileOpen macro.  Uses COMMDLG to Allow
'        selection of personalized file type extensions.
'    To use it, copy the macro to your FileOpen macro and customize
'        it suit your needs.
'    Requires CommLib macro to be installed globally.
'
' Copyright ©1993 Artemis Associates, San Jose, CA

Sub MAIN
        fname$ = "" ' No Initial Filename
        dir$ = "c:\" ' Initial Directory

        ' Filter of File Type to look for
        filt$ = "Contracts (*.cnt)¦*.cnt"
        filt$ = filt$ + "¦Letters (*.let)¦*.let"
        filt$ = filt$ + "¦Invoices (*.inv)¦*.inv"
        filt$ = filt$ + "¦All Files (*.*)¦*.*"
        title$ = "New File Open - COMMDLG"

        ' Flags for dialog box characteristics
        OFN_READONLY =
        OFN_PATHMUSTEXIST = 2048
        OFN_FILEMUSTEXIST = 4096
        flags = OFN_PATHMUSTEXIST + OFN_FILEMUSTEXIST

        ' Use Function 0 for FileOpen
        fname$ = CommLib.GetFileDlg$(0, dir$, fname$, filt$, title$, flags)

        If fname$ = "" Then Goto Bye
        On Error Goto ErrOpen

        ' Check if ReadOnly box is checked, if so, open as ReadOnly
        If(flags And OFN_READONLY) = 0 Then
                FileOpen .Name = fname$
        Else
                FileOpen .Name = fname$, .ReadOnly = 1
        End If
        Goto Bye

ErrOpen:
        msg$ = "Error Opening File, " + fname$
        r = MsgBox(msg$, "New File Open", 16)
Bye:
End Sub
```

Figure 5: **This replacement for WinWord's default FileOpen macro uses Windows' COMMDLG.DLL to display a custom dialog box.**

Unlike programming languages that support data structures, WordBasic cannot automatically calculate the size of a data structure. So before you can reserve memory for a data structure, you must first add up the size of all the data members (in this case, 72 bytes). You then pass this size to the AllocVariable convenience routine, which returns two values that describe the global memory to Windows and Windows applications—the unique memory ID (or handle) for the block, and its actual location in memory. For example:

```
lStructSize = 72
hStruct = 0 : lpStruct =
 AllocVariable(lStructSize,
 hStruct)
```

After the call to AllocVariable, the variable lpStruct contains the address (location) of the data structure, while the variable hStruct contains a unique ID of the memory block. Though both variables refer to the same chunk of memory, they are used for different purposes. You need the address in lpStruct in order to access the data structure in global memory and to pass it as an argument to the DLLACCES and COMMDLG functions, but you need the handle in hStruct to free up the memory block (using the FreeVariable convenience function) when you're finished.

One quirk of AllocVariable is that it requires the memory-handle variable (hStruct, in this case) to exist before you call it, for reasons too obscure to explain here. The code fragment above reflects this requirement; it creates hStruct and assigns it a value of 0 before calling the AllocVariable function.

INITIALIZING THE DATA STRUCTURE

Once these preparatory steps have been completed, the GetFileDlg$ interface function then proceeds to use DLLACCES's DA_Set functions to initialize those members of the OPENFILENAME structure that we plan to use as input to COMMDLG's GetOpenFileName and GetSaveFileName functions. This is the most lengthy and important section of the GetFileDlg$ interface function (see Figure 4). When building your own interface functions, you'll need to consult the documentation for the DLL to determine which members you should set before calling the DLL and which members to examine after calling the DLL.

As we noted above, GetFileDlg$ allows the calling program to specify the values of just five of the members of OPENFILENAME: the initial directory, the initial filename, the filespec filter string, the title-bar caption, and the flags. In addition to transferring these values to the appropriate places in the data structure, we also need to set up data members that represent the size of the data structure and the ID of the active window, as required by the GetOpenFileName and GetSaveFileName functions. In addition, we also need to preallocate memory to hold the filename and file title that the COMMDLG functions will return.

Unlike languages that support data structures, WordBasic cannot automatically calculate the size of a data structure.

The following code fragment shows how the function sets the first two members of the OPENFILENAME structure:

```
r = DA_SetLong(lpStruct,
 lStructSizeOff, lStructSize)
hWnd = GetActiveWindow
r = DA_SetInt(lpStruct,
 hwndOwnerOff, hWnd)
```

This routine uses the DLLACCES DA_SetLong function to assign the long integer value representing the size of the structure (lStructSize) to the data-structure member at the offset stored in the variable lStructSizeOff. It then uses DA_SetInt to assign the integer value representing the handle of the active window hWnd to the member at the offset stored in the variable hwndOwnerOff.

Handling string members of data structures is somewhat different. Remember that the data structure stores only the address of a memory buffer that contains the string, not the string data itself. The BuildLPString convenience routine is used to reserve buffers in global memory to hold the contents of each string variable and then assigns the address of each buffer to the appropriate member of the data structure.

BuildLPString's syntax is similar to AllocVariable's—it returns the location and the handle of the allocated global-memory block. The following two lines, for example, are used to initialize the filter string member of the OPENFILENAME structure by setting it to the string variable filt$:

```
hstrFilter = 0 : lpstr =
 BuildLPString(filt$, hstrFilter)
r = DA_SetLong(lpStruct,
 lpstrFilterOff, lpstr)
```

BuildLPString builds the string in global memory and then returns the address (lpstr) and the memory handle (hstrFilter). The DA_SetLong function initializes the filter string member by using the memory address of the data structure (lpStruct), the offset of the filter string member (lpstrFilterOff), and the memory address of the string (lpstr). Note that you'll use the memory-block handle (hstrFilter) to free up the memory block when you're finished.

BuildLPString also performs another service: It converts all pipe characters (|) in the input string to a NUL character (ASCII 0) before storing it in global memory. The GetOpenFileName and GetSaveFileName functions expect each component of the filter to be separated by a NUL character, but since these are difficult to enter in WordBasic, BuildString allows the filter input string to use the pipe character instead.

You can use BuildLPString in conjunction with the WordBasic String$() command to preallocate memory for string data members that you expect to receive results from the COMMDLG functions. To reserve memory for the selected filename, the following lines of code allocate a global-memory block of at least 256 bytes, assign the memory location to the data member at the offset

stored in lpstrFileOff, and assign the size of the memory block of the member at the offset stored in nMaxFileOff. (This prevents the COMMDLG functions from returning strings longer than this value.)

```
hstrFile = 0 : lpstrFile =
 BuildLPString(fname$ +
 String$(256, 0), hstrFile)
r = DA_SetLong(lpStruct,
 lpstrFileOff, lpstrFile)
r = DA_SetLong(lpStruct,
 nMaxFileOff, 256)
```

Because this filename data member (at the lpstrFileOff offset) can also be used as the input to set the initial filename displayed in the file-selection dialog box, simply add the initial filename fname$ in front of the 256-byte string buffer—created by the WordBasic String$(256, 0) function call.

CALLING AND EXITING Once we've done the complex job of setting up the data structure, calling the DLL function is almost anticlimactic: We just pass it the address of the data structure:

```
If OpenOrSave = 0 Then
 success = GetOpenFileName(lpStruct)
Else
 success = GetSaveFileName(lpStruct)
End If
If success = 0 Then
 Goto Bye
End If
```

The first argument to GetFileDlg$ is OpenOrSave, which allows the calling program to choose which of the two COMMDLG file-selection functions (GetOpenFileName or GetSaveFileName) to call. The selected COMMDLG function pops up a file-selection dialog box like the one shown in Figure 1 and handles all the user interaction from here on. It stores information (such as the name of the selected file and the status of the Read Only checkbox) in members of the data structure before returning a status. The status is then checked to see whether the call was successful. If it wasn't, an empty string is returned to the calling program.

Assuming the call to the COMMDLG function is successful, we can retrieve the output data from the data structure using the DLLACCES DA_Get functions. We are interested in only two values for the GetFileDlg$ interface routine: the selected filename and the flags (which are used to check if the user clicked on the Read Only box).

```
f$ = DA_GetString$(lpStruct,
 lpstrFileOff)
flags = DA_GetLong(lpStruct,
 FlagsOff)
```

The f$ string contains the name of the selected file, and flags is the value of the flags data member.

The final step in the GetFileDlg$ interface function is to free all the global memory used for the call to the COMMDLG function, including the global-memory blocks for string variables that were allocated by BuildLPString. Always free global memory when you no longer need it. If you don't, Windows will eventually run out of memory, and you'll have to restart WinWord or Windows.

The FreeVariable convenience routine is a handy way to perform this necessary function. FreeVariable takes only one argument: the memory handle of the block that was returned to you by AllocVariable or BuildLPString. The Bye: label before the FreeVariable calls ensures that all the memory is freed whenever the execution exits this function via calls to Goto Bye:.

```
Bye:
        FreeVariable(hTitle)
        FreeVariable(hstrFileTitle)
        FreeVariable(hstrFile)
        FreeVariable(hstrFilter)
        FreeVariable(hStruct)
```

One of the beauties of Word for Windows is configurability. Since all the menu entries, toolbar buttons, and key assignments invoke WordBasic commands, you can change the behavior of the program simply by replacing these commands with your own custom macros. Thus, if we change the name of the NewFileOpen macro mentioned above to the default name FileOpen, executing the File Open command (either by clicking on the FileOpen tool in the toolbar or by choosing File Open from the menu) will run our replacement macro rather than the default command.

Since most of the work is performed by GetFileDlg$, the NewFileOpen macro looks very simple (see Figure 5). It supplies the starting directory and filenames, builds the filter string, specifies the characteristics of the dialog box, and calls the GetFileDlg$ function with 0 as the first argument. It then calls the WordBasic FileOpen command to open up the selected file, choosing the ReadOnly option if GetFileDlg$ returned with OFN_READONLY set.

The NewFileSaveAs macro is quite similar, except that it tells GetFileDlg$ to access the COMMDLG function GetSaveFileName instead of GetOpenFileName, and that it uses the OFN_OVERWRITEPROTECT flag to prevent the user from inadvertently overwriting an existing file. (NewFileOpen uses the OFN_FILEMUSTEXIST flag to allow reselection if the user enters a nonexistent file.)

To try out these macros, start Word for Windows, open the file DLL ACCES.DOC (included in the DLLACC.ZIP file that you download from PC MagNet's Programming forum), and double-click on the line that reads "Double-click here to install the CommLib library." This installs the CommLib macro library into your global template (NORMAL.DOT), making its routines available to all your macros. It also copies the DLLACCES.DLL to your WINDOWS\SYSTEM directory. (You can click on the corresponding UnInstall sentence to reverse the process.)

Now double-click the sentence, "Double-click here to test New FileOpen." You should see a file-selection dialog box like the one in Figure 1. Try typing in a filename that does not exist and click on the OK button. The COMMDLG function should pop up a warning box and ask you to try again.

To use the NewFileOpen macro as your normal FileOpen command, open the NewFileOpen macro and copy the contents to your global FileOpen macro. It's important that you make sure to change the filter string to match the filespec patterns you wish to have. Copy the contents of the NewFileSaveAs macro to

your global FileSaveAs macro in order to use the custom file-selection dialog box when you save a file.

CONCLUSION As you can see, most of the work in calling DLL functions that use data structures is in setting up the data structure itself—defining the address offsets and assigning data to the structure members. The DLLACCES helper functions and the global-memory convenience routines described here can help out, leaving only simple tasks to be performed by the command macro itself. With a little imagination, you should be able to adapt these steps to develop your own interface routines.

When you feel comfortable with this step, you might want to try exploring the remaining functions in COMMDLG. Each of these functions uses its own custom data structure, documented in WIN31WH.HLP, the on-line help file for the Windows 3.1 Software Development Kit. DLLACCES.DOC contains a short tutorial that should help you convert this information into WordBasic terms.

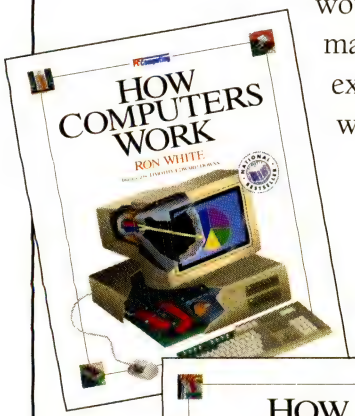
If you're on a Novell Network, you can move beyond the COMMDLG functions and explore the NetWare API (NWNETAPI.DLL) functions. The NetWare API also makes extensive use of data structures. As a first cut, try calling the GetServerInformation function. It uses the FILE_SERV_INFO data structures, which contain, among other items, the server name, the NetWare version, and the number of connections in use. You can find the Visual Basic documentation for the NetWare API functions on CompuServe in the MSBASIC forum, Lib 6, in the file NIVB.ZIP.

This article gives just a glimpse of what you can accomplish when you use DLLs and data structures. Half the fun is in finding the right DLL functions to do your bidding. And whenever you must deal with data structures, you can use the organizational tips presented here to make DLL access routines more understandable and easier to use. □

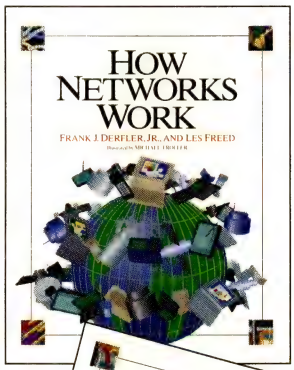
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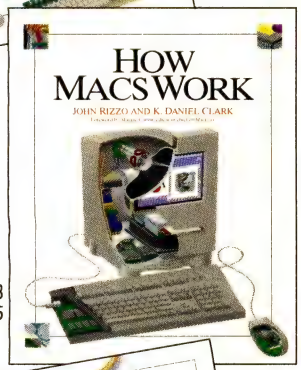
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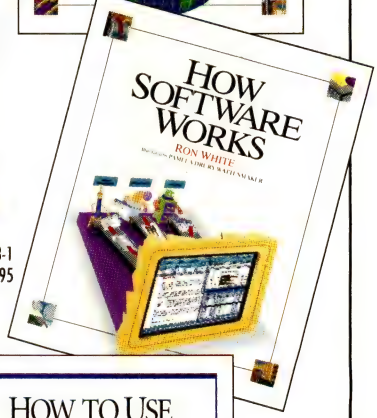
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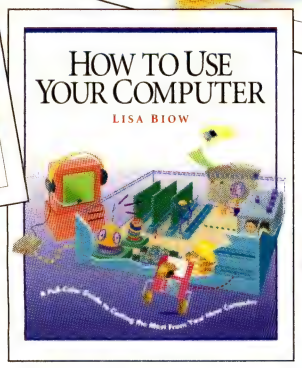
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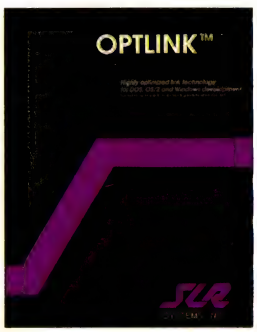
Every developer wants to produce the smallest, fastest executables possible. Small executables mean fewer disks to distribute and a shorter program load time. A good optimizing compiler is an important element in achieving this, but the linker—which merges compiled code modules and libraries to create an executable—is just as important. Unfortunately, the linkers supplied with most compilers perform a merely adequate job. An alternative is SLR Systems' Optlink for Windows, Version 5.0 ($350), which produces highly optimized executables at breathtaking speed. (A product-specific version of Optlink, Version 4.0—without the Windows programming enhancements—ships with the new Symantec C++ compiler.)

Optlink replaces the linkers that come with the Microsoft and Borland International compilers to create executables up to 50 percent faster and 50 percent smaller. The speed advantage comes simply from well-written code. Optlink for Windows runs under DOS and can create 16-bit DOS, Windows, or OS/2 EXE or DLL files—though Windows executables are its specialty. The company expects to release a version that can handle 32-bit Windows programs (Win32s and Win32) by the end of the year.

SMALL, SMALLER, SMALLEST Optlink uses a variety of techniques to shrink executables. For Microsoft C7 and later, Optlink uses a technique called "smart linking," which identifies unreferenced routines and data and omits them from the executable. Although the Microsoft linker (LINK) provides some degree of smart linking, it can't detect all unreferenced routines. If foo2() is only called by foo1(), and foo1() itself is never called, LINK cannot detect that foo2() is unreferenced. Optlink can—by virtue of a recursive algorithm.

The OBJ's produced by the Borland C++ compiler don't permit smart linking because they lack a *COMDAT record.* But Optlink can still shrink Borland executables by as much as a third by eliminating the unnecessary information written by the Borland linker (TLINK).

Optlink further shrinks executables by replacing far jumps and calls with near jumps and calls wherever possible. This lowers the number of entries in the relocation table and also improves performance, since near jumps and calls execute more quickly.



Executables can be made smaller still through compression. DOS, Windows, and OS/2 executables all can be compressed by as much as 10 percent with the /EXEPACK run-length encoding option, which is recognized and decompressed by the loader. However, the most extraordinary feature of Optlink (new with Version 5.0) is its /WINPACK option, which uses LZ-type compression to reduce the size of Windows executables by half. Since this format is not recognized by the loader, Optlink implants code into the executable for automatic decompression and loading.

You may freely distribute up to 500 copies of your software package, using WINPACK technology (regardless of the number of WINPACKed executables in the package). After that, you must pay SLR Systems a royalty based on the number of packages sold. The pricing strategy is still under review, but at the time of writing the royalty was $1.00 per package. You should contact SLR Systems for current pricing information.

LINKING WITH OPTLINK Optlink accepts full Microsoft or Borland command-line syntax. with only a few exceptions. The most important limitation is that Optlink does not support DOS overlays. To use Optlink with Microsoft compilers, you can either change your MAKE files (or IDE settings) so Optlink is executed instead of LINK or you can simply replace LINK.EXE with OPTLINKS .EXE.

Using Optlink with Borland's TLIB utility for creating libraries also requires some extra work. The data dictionaries in the object files created by TLIB have some anomalies and can't be read by Optlink. (TLINK itself does not use the data dictionary and instead searches through the libraries to find modules.)

To solve this problem, Optlink for Windows ships with a utility called FIXLIB that patches the data dictionaries. FIXLIB must be run against every library created or updated with TLIB, which can be tedious. An alternative is to purchase another SLR Systems product, Optlib ($199), which is a high-speed replacement for LIB and TLIB.

Optlink, Version 5.0, ships with the Version 4.0 manual and an addendum describing the additional features. A README.1ST file on the distribution disk, also required reading, lists corrections to the manual. All the information is given, but combining it in one complete manual would make things easier.

Optlink for Windows is careful to trim the fat from your executables—especially Windows executables—and is still significantly faster than the Borland or Microsoft linkers. Optlink is a must-have for serious developers. □

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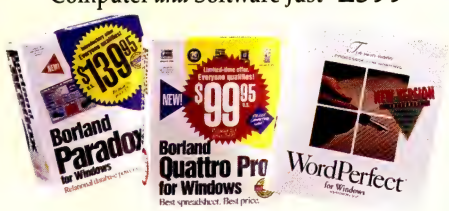
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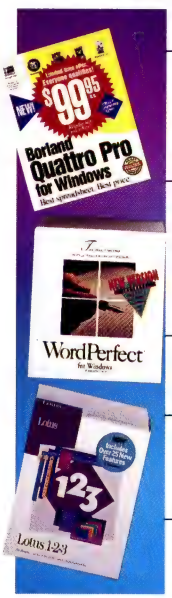
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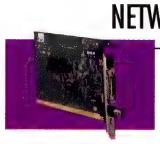
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Power Programming

BY KAARE CHRISTIAN

Making Exceptions With C++

Languages, snails, monkeys, and man—one thing they have in common is evolution. C++, like English, is an evolving language. The version of C++ most of us use today is somewhat less advanced than the full language envisioned by the standardization committee, but considerably more evolved than the form of C++ used in the late eighties. For example, early implementations of C++ didn't support multiple inheritance (MI). Imagine C++ with only single inheritance. Today, MI is found in all implementations of C++, and nobody would take seriously a C++ compiler lacking MI support.

The exception is a recently implemented C++ language feature that helps you manage show-stopping runtime errors, especially those that occur after deeply nested function calls. The only C++ compiler that supports ANSI standard C++ exceptions at the time of this writing is Watcom C++. Microsoft Visual C++ and Symantec C++ support a nonstandard version of exception handling through the MFC (Microsoft Foundation Class) application framework. Version 4.0 of the Borland C++ compiler, slated for release around the time you read this, will support the full ANSI standard for exception handling.

Exceptions are basically the C++ equivalent of the C language's setjmp() and longjmp() routines, but include features to handle the special requirements of C++ programs. An express-lane retreat to an exception handler from a deeply nested subroutine (Figure 1A) is generally a better way to manage errors than returning a series of error conditions up through the subroutine chain (Figure 1B). C++ exceptions are less error prone, and they let you impose an error-handling strategy on a program. You can classify error conditions, and then regularize your response to those errors.

Besides these general programming advantages, another reason to understand and use C++ exceptions is to write elegant and bullet-proof applications using MFC and Version 2.0 of OWL (ObjectWindows library), which will ship with Borland C++, Version 4.0. Exceptions are central to both of these application frameworks.

Let's start by reviewing the C "exception" mechanism, and then spend some time covering the new C++ exception mechanism. The last half of this article will discuss exceptions and Windows, and will show how to use exceptions in both the MFC and OWL class libraries.

C EXCEPTIONS The C language provides exception handling through its setjmp() and longjmp() functions. These functions are roughly equivalent to a statement label and a goto statement, except that goto only works within a function, while longjmp() lets you jump to a remote function. Another difference is that goto is part of the C language, while setjmp() and longjmp() are part of the C runtime library, and runtime library implementations vary slightly from compiler to compiler.

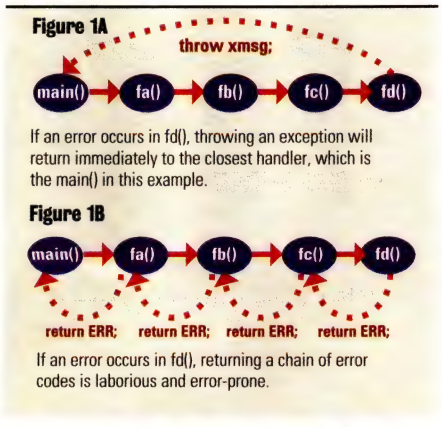


Figure 1: **Exception handling lets you go directly from the site of the problem to the site of the solution, as in Figure 1A. The alternative is to return error values, as shown in Figure 1B.**

The basic idea is pretty simple. You call the setjmp() function at the point to which you'd like to return if a runtime error occurs. Setjmp() saves the state of your system at that point in your program, including the current instruction (the IP register), the position on the stack (the SP and BP registers), and the contents of most of the other processor registers. This state information is saved in a jmp_buf data structure, whose address is a parameter of setjmp(). Subsequently, you can call longjmp(), passing it the saved jmp_buf data structure, to return to the setjmp() location and restore the prior state.

Here's a typical function that uses setjmp() to store the current state so that control can be returned to the setjmp() point:

```
#include <setjmp.h>
jmp_buf aJmpBuf;
void fna()
{
      int retval;

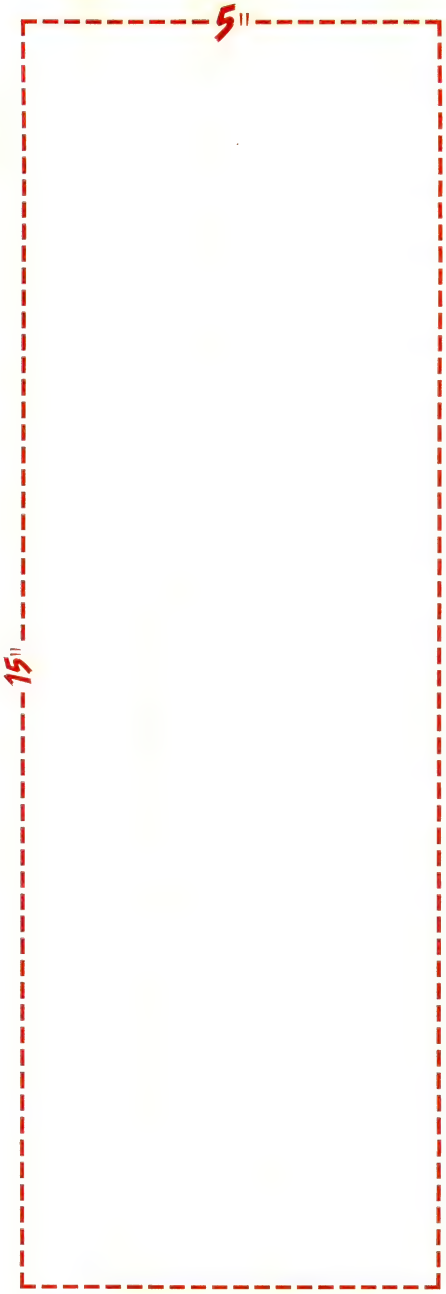
      retval = setjmp(aJmpBuf);
      if (retval) {
            printf("Got here by
             longjmp()\n");
            exit(-1);
      }
      fnb();
      fnc();
      . . .
}
```

Into fna() or fnb() or any subroutine that they call you can place the following line to return to the setjmp() location:

```
longjmp(aJmpBuf, 1);
```

The second argument, 1, is the return value. You can check the return value in setjmp() to see where you jumped from.

Setjmp() and longjmp() encourage



Small Footprint.

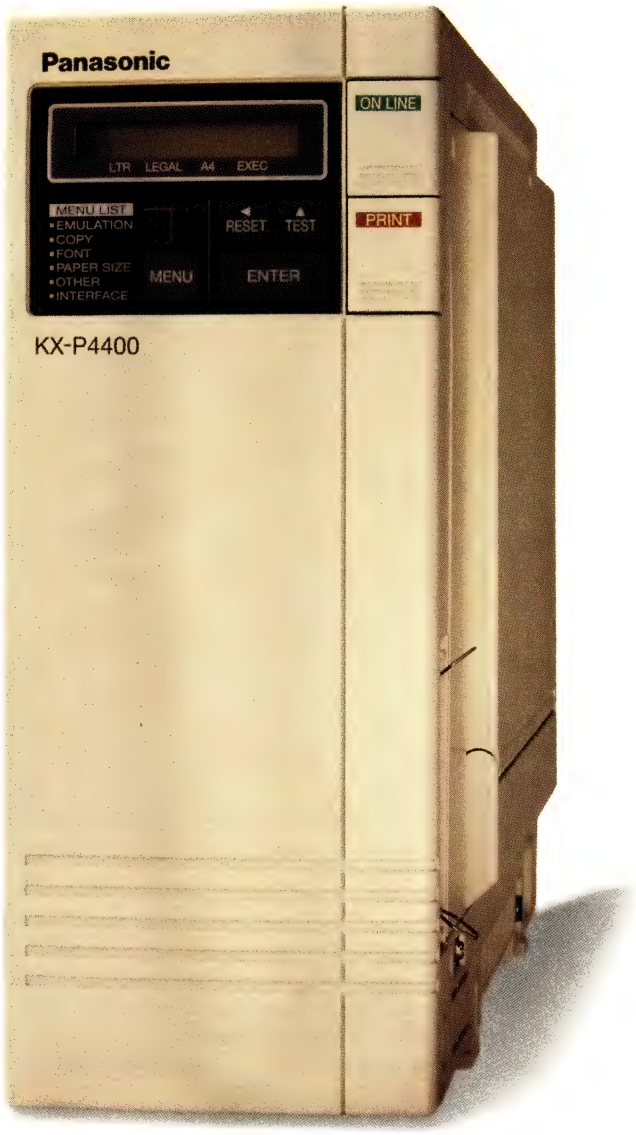


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structured programming by providing a way to exit cleanly when a critical leg of a complex task fails. For example, the selection of a menu item may trigger a complex series of nested functions and procedures that, if successful, result in a graphical display. If any of the functions that build the display fail, you want to be able to cancel the entire set of nested calls and return to the point before the menu selection was made. Setjmp() and longjmp() let you do this without using the unstructured approach of putting all the code into a single procedure.

Still, setjmp() and longjmp() have some drawbacks and limitations:

- Setjmp() and longjmp() are unsafe. The setjmp()/longjmp() assumption, shown in Figure 2A, is that longjmp() is returning to an active subroutine, one whose state is still on the stack. But nothing prevents the programming error shown in Figure 2B, in which a longjmp() is made to a procedure that has already returned. The behavior in this case is undefined and likely near-random. Aside from careful coding, the only way to ensure that this error does not occur is to call setjmp() from the main() function.
- Setjmp() and longjmp() cannot be used in DOS programs that are overlaid, because these functions' method for saving and restoring the system's state assumes there is only one stack.
- With Borland's C++ 3.1, setjmp() and longjmp() cannot be used with Windows programs; you must use Catch() and Throw(), equivalent functions that are part of the Windows API. On a more dire note, its manual states that the Microsoft Visual C++ versions of setjmp() and longjmp() are "incompatible" with the C++ language.

Setjmp() and longjmp(), therefore, are fine for nonoverlaid DOS programs written in C, while Catch() and Throw() are available for Windows programs. But if you're using C++, the best method is the C++ exception mechanism.

C++ EXCEPTIONS The C++ exception mechanism was first proposed by Bjarne Stroustrup, the creator of C++, and Andrew Koenig, a well-known and long-time contributor to the C++ community, at the 1990 USENIX C++ conference. Their scheme is detailed in Margaret A. Ellis and Stroustrup's 1990 book *The Annotated C++ Reference Manual* (Addison-Wesley), although the scheme is labeled "experimental." Today, the exception mechanism, like the C++ standard itself, is not yet finalized, but the basic elements are not likely to change as newer versions evolve.

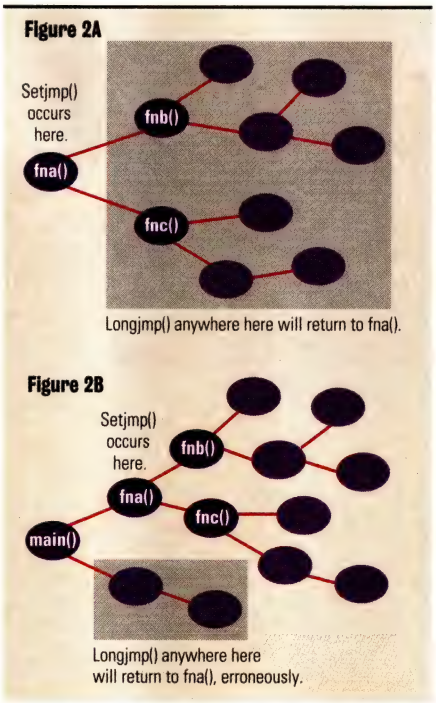


Figure 2: **Calling longjmp() works correctly only if the procedure that called setjmp() is still active, as in Figure 2A. If the procedure that called setjmp() has returned, the longjmp() is erroneous, as in Figure 2B.**

The C++ exception mechanism introduces three new keywords:

- *try* blocks introduce a block of code in which exceptions will be handled,
- *catch* blocks, the actual handlers, follow try blocks, and
- *throw* statements are used to generate (throw) exceptions.

With C++, you differentiate between different types of exceptions by using different data types to signal the exceptions. So if you want to handle out-of-memory error conditions, for example, then you need a data type for that purpose. If you want to handle "the network just went down and we can no longer fetch SQL records from the server" errors, then you need a data type for that purpose. You can associate any data type with a specific type of error condition, but usually you use a base type, such as the ANSI C++ xmsg class, as a generic exception type, and then derive new types for each specific exception condition.

Let's start with a really simple example. Let's say that our program might have runtime errors due to string operations or due to numeric operations. We need two data types to deal with these two types of problems: For string problems, we'll throw a `char*` exception, while for numeric problems we'll throw a `double` exception. (This example is simplified; in actual code, you'd use exception types derived from the C++ xmsg class.)

Figure 3 shows how we might be able to define the `try` and `catch` blocks in which these two types of exceptions will be trapped and handled. What's not shown in Figure 3 is the body of the `try` block, which in this simple case is likely to be the body of the program. In the `try` block, or in any subroutine called from

TRY AND CATCH BLOCKS

Partial Listing

```
try {
        //
        // the try block
        // call subroutines, . . .
        //
}
catch (char * p) {
      printf("Caught a char* exception, value %s\n", p);
}
catch (double d) {
      printf("Caught a numeric exception, value %g\n", d);
}
catch(...) { // catch anything
       printf("Caught an unknown exception\n");
}
```

Figure 3: **The *try* block is the portion of the code where exceptions may be thrown; the *catch* blocks are the actual exception handlers.**

the `try` block, you can throw an exception in order to immediately break out to the appropriate handler. For example, the following code will transfer control immediately to the first `catch` statement shown in Figure 3 if `ptr` is null:

```
char *ptr = (char *)malloc(100);
if (ptr == NULL)
        throw "null pointer";
```

Similarly, the following statement will transfer control to the second exception handler in Figure 3 if `val` is very small:

```
double val;
getDlgCtrlVal(IDXLOC, &val);
if (fabs(val) < 1e-6)
        throw val;
else
        result = x / val;
```

If you throw any other type of exception from within the body of the `try` block, it will be caught by the third handler in Figure 3, which is a catch-all handler.

The order of exception handlers (catch blocks) matters a great deal, because each exception handler is tried in turn and the first match takes control. Placing the catch-all handler—the catch(. . .) handler—anywhere but last wouldn't make much sense, because nothing that follows will ever gain control. You must be especially careful when exceptions are base and derived class types. If the derived types don't come first in the handler list, the base class will always match and take control.

You may, of course, place any number of handlers following the `try` block. But you can't place a handler just anywhere; it has to be placed after a `try` block or another handler.

Some exceptions are best handled close to where the error occurred, while others can be handled by general purpose handlers located farther up the nested function tree. You can implement this by nesting `try` and `catch` blocks, handling certain exceptions locally, and rethrowing other exceptions to the next closest handler. To do this, you use the `throw` keyword with no parameters:

```
catch(. . .) { // catch any
 exception
   printf("Caught an unknown
    exception\n");
   throw; // re-throw current
    exception
}
```

In this example, if an unknown exception is thrown, it's trapped by the catch-all block and rethrown to the next catch block of the appropriate type, which is presumably a general-purpose handler for this type of exception.

And one last point. If an exception is thrown but there's no matching handler, then the exception terminate function is called. By default, the terminate function does just that—terminate the application. Though you can install your own terminate function using the set_terminate() function, a more graceful way of preventing program termination is always to use a catch-all block.

MFC Exception Macros

Macro	Action
TRY	Start a try block.
CATCH(type, object)	Start the first handler at the end of a try block. Type is the type that will be caught; object will be declared inside the block and will hold the exception object.
AND_CATCH(type, object)	Start subsequent handlers (CATCH for the first, AND_CATCH for subsequent).
END_CATCH	Use after CATCH or AND_CATCH to terminate the list of handlers.
CATCH_ALL(object)	Catch all exceptions. You can find out what particular exception has been caught by calling the IsKindOf() member function.
AND_CATCH_ALL (object)	Use after CATCH or AND_CATCH to catch any exception.
END_CATCH_ALL	Use after CATCH_ALL or AND_CATCH_ALL to terminate the list of handlers.
THROW()	Throw an exception. Alternatively, you can use one of the supplied AfxThrow... functions directly (Table 2).
THROW_LAST( )	Throw the exception that was just caught. (May only be used in a handler.)

Figure 5: **MFC simulates C++ exception handling through the use of macros.**

XMSG CLASS EXCEPTIONS

Partial Listing

```
try {
        //
        // the try block
        //
}
catch (xalloc& x) { // catch reference, catch derived class first
        printf("Caught an xalloc exception, name %s, value %d\n",
                x.why().c_str(), x.requested());
}
catch (xmsg& x) {  // catch reference, catch base class second
        printf("Caught an xmsg exception, name %s\n",
                x.why().c_str());
}
```

Figure 4: **The order of the catch blocks is important; derived classes must be listed before base classes.**

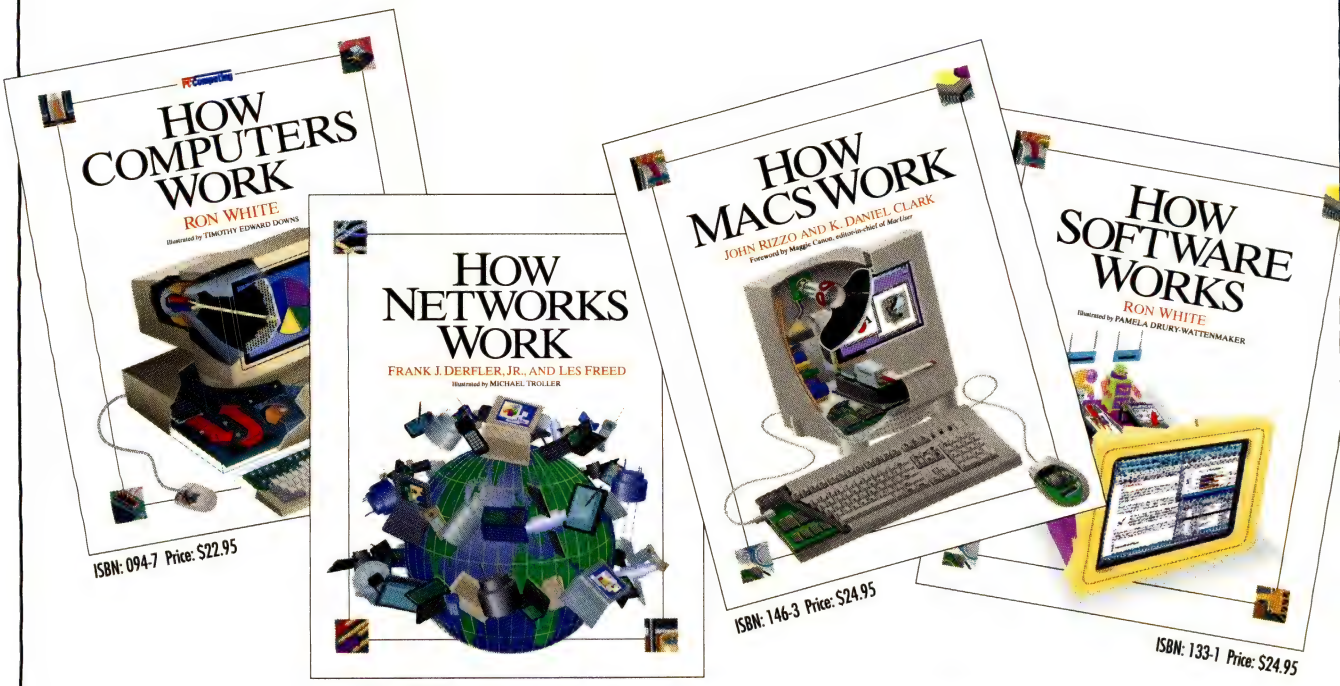
WHAT ABOUT LOCAL OBJECTS? C and C++ differ in what happens when functions are entered and exited. In C, the only thing that happens on function entry is that space is set aside on the stack for local variables. C++ not only sets aside space for local variables, but on function entry, C++ calls constructors for all local objects, and on function exit it calls destructors for local objects.

Automatic invocation of constructors and destructors is one of the great things about C++ objects. Constructors and destructors let you specify just what happens when objects are created and destroyed. In many classes, the tasks performed by destructors are crucial. For example, some classes maintain reference counts or lists of class objects. In these types of classes, obliterating an object without first calling its destructor will cause problems later.

So what happens to local objects when, because of an exception, a function is entered but never exited? The ANSI standard behavior is to call all the de-

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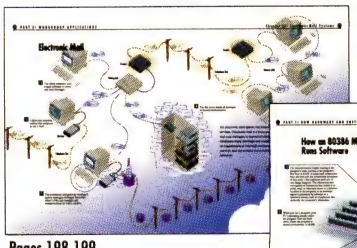
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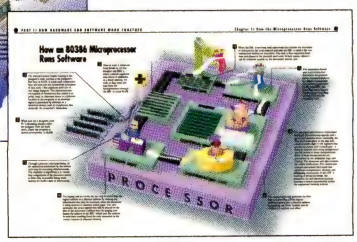
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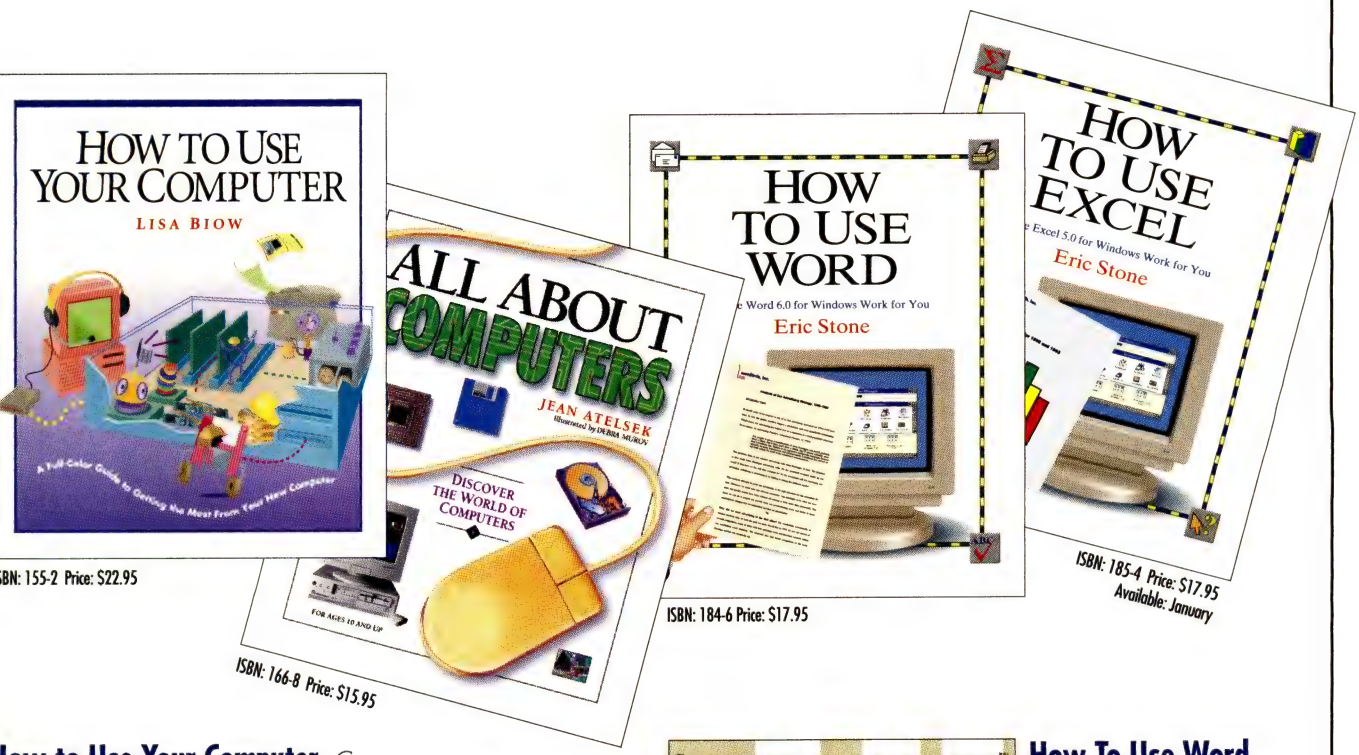
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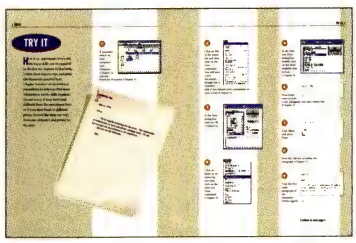
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structors for stacked objects between where the exception was thrown and where it was caught. This is the default behavior with Borland C++, Version 4.0, though you can change the default through a dialog box. The nonstandard MFC implementation does not automatically call destructors; you must call them yourself in the catch block.

Since the execution of destructors is the standard way of cleaning up after exceptions, setting up the destructors to perform all necessary cleanup tasks is important. For example, consider a little function called BusyBee():

```
void BusyBee(void)
{
        char *p = (char *)malloc(100);
        CSomeObject someObj;
        // body of Bee goes here:
        // call other functions, etc.
        free(p);
}
```

Let's say an exception is thrown while BusyBee() is active (that is, an exception is thrown from within BusyBee() itself or from some routine called by BusyBee()). The compiler can call the destructor for someObj, but it won't free the storage allocated by the `malloc`. Memory leak! The solution is to encapsulate all memory allocations into C++ objects and make sure the destructors free all resources.

ANSI's XMSG CLASS Although using C++'s built-in types (char, int, double, and so on) for throwing exceptions is possible, creating types specifically for exceptions is good programming practice. The xmsg class, which is present in all compilers that support ANSI exception handling, is provided for this purpose and contains special features that ease exception handling. With xmsg, you can use

MFC EXCEPTION HANDLING

Partial Listing

```
TRY
{
        //
        // try block, code goes here!
        //
}
CATCH(CMemoryException, e) {
        printf("Caught a memory exception.\n");
}
AND_CATCH_ALL(e) {
        printf("Caught an exception\n");
}
END_CATCH_ALL
```

Figure 7: **The MFC exception-handling syntax is not compliant with the ANSI standard, but the syntax is very similar.**

C++ classes to form families of exception types. Thus, you can either catch individual exceptions (by catching derived classes) or groups of exceptions (by catching base classes).

The definition of the ANSI xmsg class is as follows:

```
class xmsg
{
public:
    xmsg(const string& msg);
    xmsg(const xmsg& msg);
    ~xmsg();
    const string& why() const;
    void raise() throw(xmsg);
private:
    string *str;
};
```

Basically, the xmsg class stores a string, and it can print that string using the why() method. The `const` suffix after the why() method indicates that why() is a constant method—that is, it will not change the value of the string. You can create an xmsg object by supplying the constructor with a string or an existing xmsg object. (The xmsg class uses the C++ string class, which is another recent ANSI-ism. There's a lot to look at in the string class, and we may in a future column, but for now you can just think of char* wherever the xmsg class says string, because the C++ string class can convert from char* to string.)

The raise() method of xmsg shows another feature of exceptions that I've not yet mentioned. You can specify what exceptions a function is expected to throw by placing a list of possibilities after the function declaration. The syntax is to place the word `throw` followed by a parenthesized list of types after the function declarator. In the xmsg base class, the raise() method only recognizes xmsg exceptions, because that's the only type of exception listed. If some other type of exception is thrown, the compiler will call the unexpected() function. By default, unexpected() calls terminate(), and terminate() usually terminates the application. You can install your own unexpected() function by calling set_unexpected(), which works similarly to set_terminate(). (Raise() itself is an ANSI C way of handling certain types of errors.)

If you create a family of exception types by deriving from xmsg, you'll probably add data members for each type so that you can record information about the failure. For example, ANSI defines an xalloc class derived from xmsg that can be used when there is a memory allocation failure:

```
class xalloc : public xmsg
{
public:
    xalloc(const string &msg, size_t
      size);
    size_t requested() const;
    void raise() throw(xalloc);
private:
    size_t siz;
};
```

The xalloc class stores the size of the failed allocation; you must supply the

MFC Exception Types

Exception Type	Throw Function	Dos	Win
CException		√	√
CMemoryException	AfxThrowMemoryException()	√	√
CFileException	AfxThrowFileException()	√	√
CArchiveException	AfxThrowArchiveException()	√	√
CNotSupportedException	AfxThrowNotSupportedException()	√	√
CResourceException	AfxThrowResourceException()		√
COleException	AfxThrowOleException()		√
CUserException	AfxThrowUserException()		√

Figure 6: **The AfxThrow... functions are called by MFC's THROW macros; you can also call them directly.**

MFC STACK UNWINDING
Partial Listing

```
void myBuddy()
{
        CSomeObject obj;
        TRY
        {
                // call functions that might
                // throw an exception
        }
        CATCH_ALL(e) {                    // catch anything
                obj.~CSomeObject();       // call destructor
                THROW_LAST();             // re-throw
        }
        END_CATCH
}
```

Figure 8: **MFC does not include automatic stack unwinding, as required by the ANSI standard, so you must call destructors manually.**

constructor with a message string and with the size of the failed allocation.

When you catch exceptions from a family of exception types, you should catch exception objects by reference rather than by value. This helps with efficiency, but more importantly it lets you get at polymorphic behavior of the object. This rule is followed in Figure 4, which shows a `try` block that can catch xmsg and xalloc exceptions. Here's how an xalloc exception might be thrown:

```
*const int bufSize = MAXNAMELENGTH;
char *p = (char *)malloc(bufSize);
if (!p) {
      xalloc xa("string malloc
       failure", bufSize);
      throw xa;
}
```

If your thinking cap is firmly in place, you might wonder whether the throw will work properly. First, after a malloc failure, what will happen during the construction of the xa object? Space for xa itself won't be a problem because xa will be on the stack. But if xa needs to dynamically allocate space for its members, you can take care of that difficulty by supplying a class-specific operator-new() function that uses a reserved pool of memory.

The second apparent problem is that the xa object is allocated on the stack but is used by the exception handler, which is outside the scope of the function. Remember the C (and C++) rule that says you should never return a pointer to a local variable since the variable will not exist outside the scope of the function? Well that rule appears to be violated in this case. The reason it's not violated is that, because xa is an exception, the compiler makes a copy of the xa object when `throw` is called and passes the copy, by reference, to the handler.

That's also why the xmsg class has a copy constructor. When the compiler needs a copy of a stack-based object, the compiler calls the object's copy constructor. If no copy constructor is defined, the compiler builds one automatically. It's good programming practice to supply a copy constructor for all your classes so you can tend to the all of the details of copying, instead of passively letting the compiler do it.

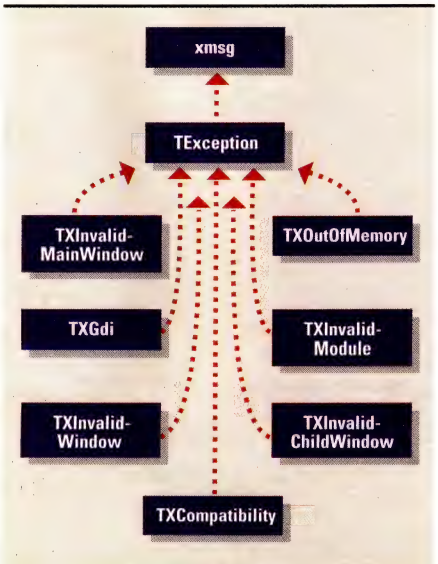


Figure 9: **Borland's OWL, Version 2.0, uses an exception-class hierarchy derived from the C++ xmsg class.**

MFC EXCEPTIONS Microsoft's Foundation Class library (MFC), Versions 1.0 and 2.0, supports exceptions using a nonstandard syntax. Microsoft's press releases say that the next major release of Visual C++ will support full C++ exceptions, and so MFC will be revised slightly to take advantage of the standard C++ exception mechanism.

The MFC approach is very forward-looking, given the fact that it was developed years before any PC compiler vendors were ready to put full C++ exception handling into their product. I've heard people criticize MFC's scheme for being different from the emerging ANSI standard, and it's a criticism that's based on a nugget of truth. But the counterargument is more compelling to me; MFC's exception scheme is useful, it was designed with ANSI clearly in mind, and it's been on the job, working hard, for about two years.

The MFC library's exception mechanism is based on the exception macros listed in Figure 5 and on the exception types listed in Figure 6. The CException type is a generic exception type from which all the other exception types are derived. Depending on the type used as a parameter of the THROW macro, a different AfxThrow... function is called (see Figure 6).

The macros resemble the C++ exception keywords and work similarly, which should make conversion straightforward when the compiler fully supports the new mechanism. To catch exceptions using the MFC library, you create a TRY block followed by CATCH blocks (Figure 7). As you can see, MFC uses slightly different syntax than the emerging standard, but the differences are trivial.

Throwing exceptions in MFC is slightly different from the C++ proposed standard. MFC's solution to the problem of throwing objects created on the stack is the use of the AfxThrow... functions, which you can call directly, or indirectly via the THROW macro. Each of the AfxThrow... functions has an associated static exception object. When an AfxThrow... function is called, it throws a prebuilt static exception object rather than the temporary stack version.

When you call one of the MFC member functions or constructors that throws

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exceptions, you must explicitly perform any necessary cleanup. The best way to handle this is to catch the exception, clean up locally, and then pass the exception along (Figure 8). The object created on the stack is cleaned up by calling its destructor explicitly. If the object had been created by calling new, then the handler would call delete to deallocate the object.

OWL EXCEPTIONS Borland's application-framework class library is OWL (ObjectWindows library). Version 1.0 of OWL does not manage errors using exceptions. Version 2.0, which will accompany Borland C++, Version 4.0, will make full use of true C++ exceptions. Our discussion of OWL pertains only to Version 2.0.

Borland's OWL exception classes are diagrammed in Figure 9. OWL derives the TException class from the standard ANSI xmsg class, and then derives specialized exception classes from TException. Because Borland supports full stack unwinding (destruction of stacked objects when an exception occurs), OWL exceptions are easier to work with than MFC exceptions. Stack unwinding is the default behavior, but you can turn it off if you choose.

OWL provides two built-in handlers: one in WinMain() and the other in OWL's window proc. If WinMain() catches an exception, it will terminate the program. If the OWL window proc catches an exception, it will call TModule::Error(). Since Error() is a virtual function, you can supply your own version. You can also install try blocks inside routines that call OWL functions capable of throwing exceptions. Local handlers give you the best opportunity for dealing with exceptions intelligently, instead of generically.

THEY'RE NOT EXCEPTIONAL ANY MORE Exception handling is fast becoming the rule, not the exception. If you're working with C++, and especially if you're working with MFC or OWL, you need to move to C++ exceptions so that all parts of your program can be on the same wavelength for runtime error management. □

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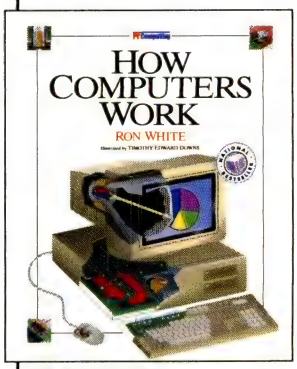
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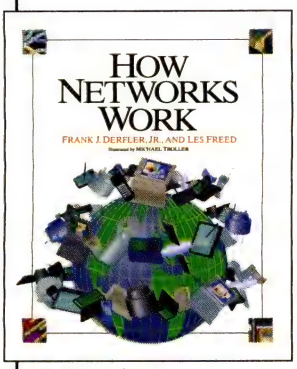
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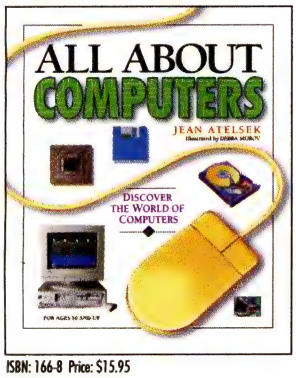
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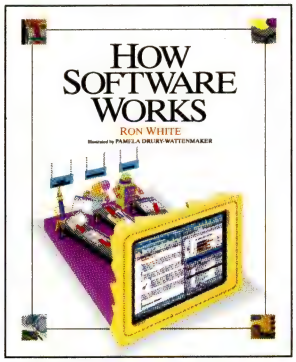
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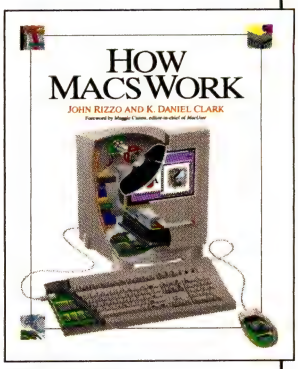
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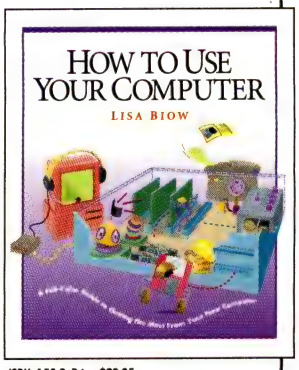
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Utilities

BY DOUGLAS BOLING

Taking Command Away from COMMAND.COM

While most utilities add to the things DOS can do, this issue's offering lets you prevent DOS from doing things you don't want it to.

When you tell DOS to run a program, COMMAND.COM always begins by searching for it in the current directory. If you're a power user who puts his most frequently used programs on a RAM disk, however, this useless search is a waste of time, made all the more frustrating if you're currently working from a floppy disk. QPATH (short for *quick path*) lets you tell DOS where it should look first, before it looks in the current directory or in other directories listed in your regular path.

QPATH also lets you prevent DOS from executing the commands you specify. Normally you'd probably use this feature to disable such internal commands as DEL and ERASE, so that the uninitiated—or the malicious—can't erase files from the hard disk of a machine used for demos or in kiosks. QPATH will block not only internal DOS commands, however, but also any command or batch file name you give it that is not preceded by an explicit pathname.

At a little over 1,000 bytes, QPATH is a small TSR (Terminate and Stay Resident) utility. It will work on systems running DOS 3.3 or later but is not compatible with earlier versions of DOS or with DESQview.

If you would like to add the QPATH functions to your system, both the executable program and its assembly-language source can be downloaded from PC MagNet, as explained in the sidebar "Guide to Our Utilities & How to Get Them." If you don't have a modem, you can send your request to Public Brand Software, P.O. Box 51315, Indianapolis, IN 46251; 317-856-4144; fax, 317-856-2086. Be sure to specify your preferred disk size and density.

Assembling QPATH requires no more than an assembler compatible with Microsoft's MASM assembler. The requisite MASM commands are

```
MASM QPATH;
LINK QPATH;
EXE2BIN QPATH QPATH.COM
```

Top 10 Utilities

Rank	Utility
1	**INCTRL** - *Installation control*
2	**CLIPST** - *Extends the clipboard*
3	**CHANGER**- *Changes look of desktop*
4	**WINCMD** - *Command file interpreter*
5	**RCLICK** - *Puts menu bars at cursor*
6	**FNTPRN** - *Catalogs your fonts*
7	**WINTIDY** - *Organizes program manager*
8	**BUGS** - *Windows 3.1 screen saver*
9	**WPRINT** - *Prints in Windows 3.1*
10	**WTIME** - *Keeps PC clock accurate*

This list is based on the total number of downloads each utility has had on PC MagNet over the past 12 months. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "How to get PC Magazine's Utilities."

USING QPATH To install the utility, just enter QPATH at the command line. On 386 and 486 machines, you can load it in the upper memory blocks by using the DOS 5.0 LOADHIGH command or by executing the appropriate command in such memory managers as 386MAX.

Once loaded, QPATH uses the string assigned to the environment variable QPATH as its search path for programs. The DOS SET command assigns the string to the variable. For example, I set QPATH to look on my RAM disk E: and in the UTIL directory on my second hard disk by including the following line in my AUTOEXEC.BAT file:

```
SET QPATH=E:\;D:\UTIL
```

You can change the QPATH variable at any time because QPATH checks the contents of the variable each time a command is entered. As with the PATH environment variable, the semicolon (;) character must separate directories in the QPATH variable and there must be no spaces between the variable name QPATH, the equals sign, and the list of directories in the SET QPATH command.

Once QPATH is installed, the COMMAND.COM search sequence is as follows:

(1) Internal commands such as COPY and DEL;

(2) Directories listed in the QPATH environment variable;

(3) The current directory;

(4) Directories listed in the PATH environment variable.

DOSKEY users should note that since DOSKEY processes commands *before* they reach COMMAND.COM, QPATH will have no effect on the execution of DOSKEY macros.

The COMMAND.COM search sequence terminates as soon as a match is found, so if the program is found in the quick path no search of the current directory is made.

The full syntax for the utility can be seen at any time by entering QPATH /?, and is as follows:

```
QPATH [/D][/E][/U][/X cmd[, . . .]]
```

The four optional command line

FINDINSTALLED

Complete Listing

```
;-------------------------------------------------------
; FINDINSTALLED - Finds any installed copies of the program
; in memory.
; Exit: Sets the already installed flag
;       ES points to installed segment or CS if no copy ;
;       found.
;       CF - Set if all Multiplex IDs used
;-------------------------------------------------------
findinstalled   proc    near
                assume  cs:code,ds:code
                mov     cx,36               ;36 = 0FF - 0DB
find_copy1:
                xor     ax,ax               ;Zero ES
                mov     es,ax
                push    ds
                push    cx
                mov     ah,multiplex_id     ;Load ID.  Use Int 2Fh to
                int     2fh                 ;  reach installed code.
                pop     cx                  ;  Search IDs 0DB to 0FF. We
                pop     ds                  ;  could start at 0C0 but I like DB.
                or      al,al
                je      find_copynf         ;If AL <> 0, ID used.
                mov     si,es               ;See if ES <> 0. If so,
                or      si,si               ;  compare headers.
                jne     find_copy3
find_copy2:
                inc     multiplex_id          ;ID already used.
                loop    find_copy1            ;  Change and try again.
                mov     dx,offset errmsg4     ;All IDs taken, print
                stc                           ;  error.
                jmp     find_copyexit1
find_copy3:
                push    cx
                call    cmpheader         ;See if correct program
                pop     cx                ;  by comparing file
                jne     find_copy2        ;  headers.
                inc     alrdy_installed   ;Set installed flag
find_copyexit:
                clc
find_copyexit1:
                ret
find_copynf:
                push    cs
                pop     es                      ;If AL not changed, prog
                jmp     short find_copyexit     ;   not installed.
findinstalled   endp
```

Figure 1: **The Findinstalled routine uses the multiplex interrupt (2Fh) to locate any previously installed copies of the program.**

switches give you full control over QPATH's operations. The /X switch lets you specify any commands or filenames that COMMAND.COM should disable (eXclude). Each command in the list that follows the /X parameter must be separated by a comma. Thus, for example, to prevent COMMAND.COM from executing the DEL and ERASE commands, the command would be

```
QPATH  X DEL,ERASE
```

After QPATH has been installed with its /X parameter, an excluded command entered at the command line will simply be ignored and the DOS prompt will be redisplayed, awaiting another command. To change the list of excluded commands, QPATH must be uninstalled (see below), then reinstalled with a new /X command.

If you wish to disable an internal DOS command so that you can execute a same-named command or batch file of your own, you can either enter the latter via a DOSKEY macro (DOS 5.0 or later), or you can explicitly supply the full pathname of your substitute.

The /D switch disables QPATH. While disabled, QPATH will not look in the QPATH directories, nor will it prevent COMMAND.COM from executing any excluded commands. The /E command line switch reenables QPATH. Finally, the /U command uninstalls the utility. Remember, you must uninstall any TSRs that you installed after QPATH before you uninstall QPATH itself. (As a side note, if TSRs installed after QPATH do not take over interrupts 21h or 2Fh, you can still uninstall QPATH, but this will create a 2K "hole" in memory.)

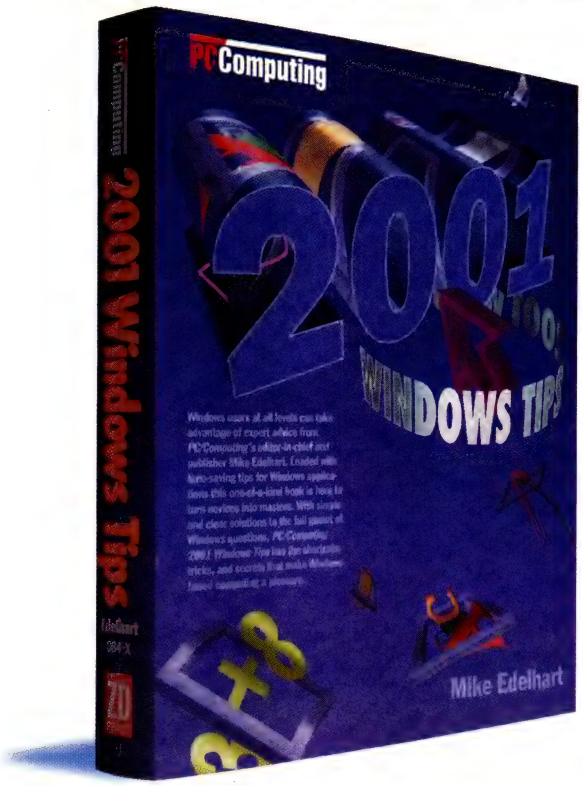
A PEEK AT COMMAND.COM Before exploring QPATH's inner workings, it would be helpful to discuss a few things about COMMAND.COM. The reason QPATH requires DOS 3.3 or later is because in that version, IBM added a "hook" into COMMAND.COM that allows other programs to examine commands that COMMAND.COM is about to execute. QPATH uses this hook to prevent COMMAND.COM from executing the commands you specify.

IBM's intent in adding this hook was to enable TSRs to add and implement additional internal COMMAND.COM commands. For example, before DOS 6.0 made this unnecessary, you could have a TSR that was written to implement a MOVE command. If you then entered MOVE, COMMAND.COM would ask the installed programs if any had implemented such a command. The TSR would then claim MOVE as its command and would perform the proper actions. If no TSR claimed MOVE, then COMMAND.COM would look for and try to execute a program named MOVE.

As with many other things about DOS, this hook has never been officially documented. The best source of information about the undocumented features of COMMAND.COM is the chapter entitled "Command Interpreters" in Jim Kyle's *Undocumented DOS*. In this chapter, Kyle discusses not only the command hook but many other interesting aspects of COMMAND.COM.

COMMAND.COM uses the multiplex interrupt (2Fh) as a vehicle to notify other programs about pending commands. It does this by calling function AE00h (the Installation Check) of the multiplex interrupt (2Fh). A TSR that needs to implement additional commands must install an ISR (Interrupt Service Routine) to receive the command notifications sent by COMMAND.COM. The TSR must also retain the old interrupt vector for the multiplex interrupt. When the ISR receives a notification that

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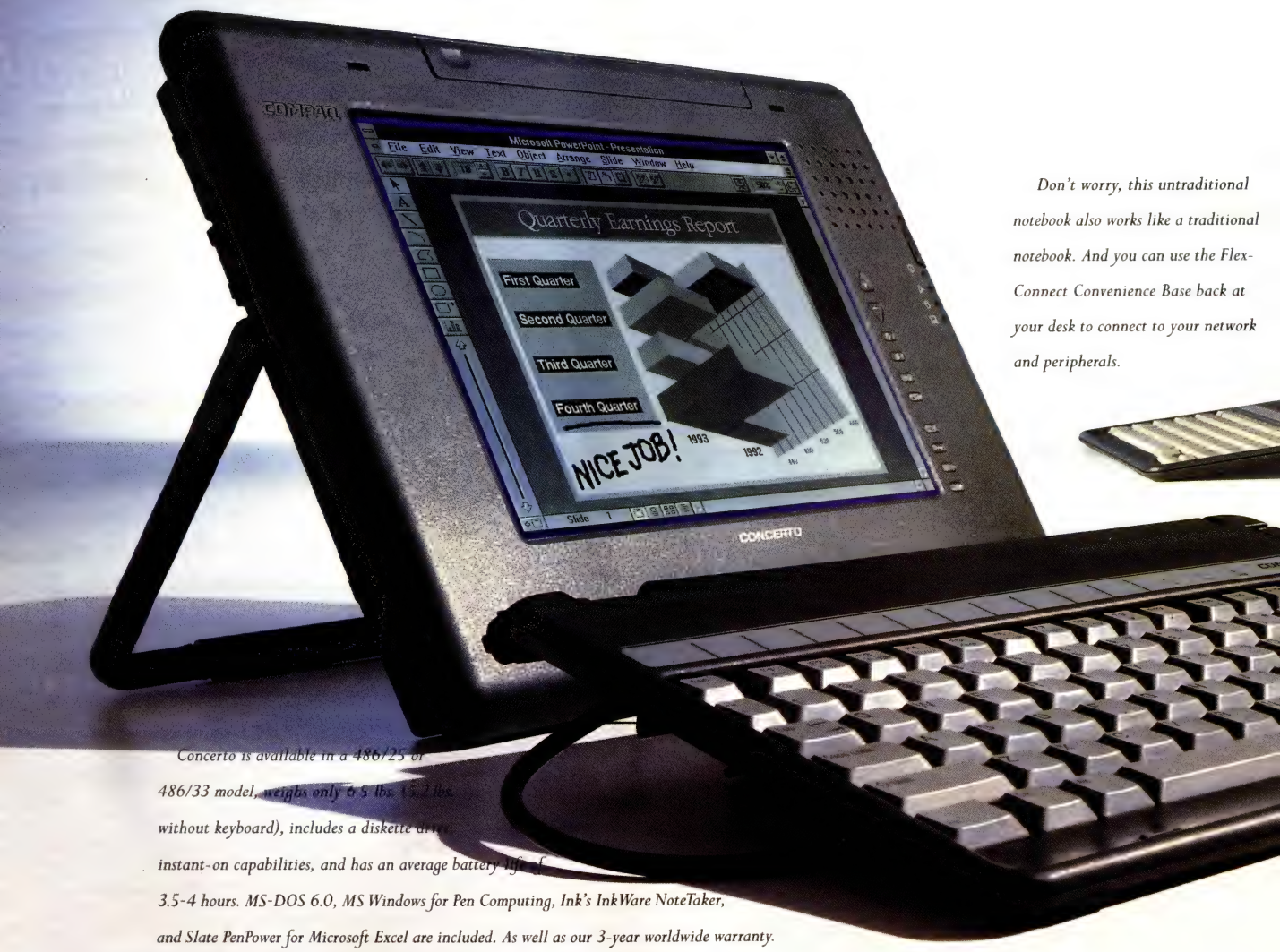
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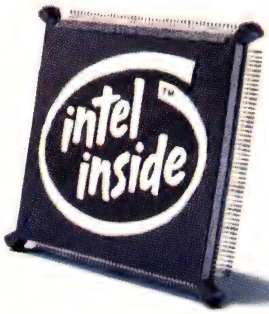


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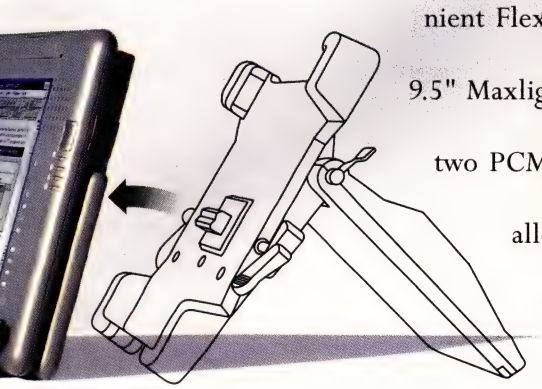


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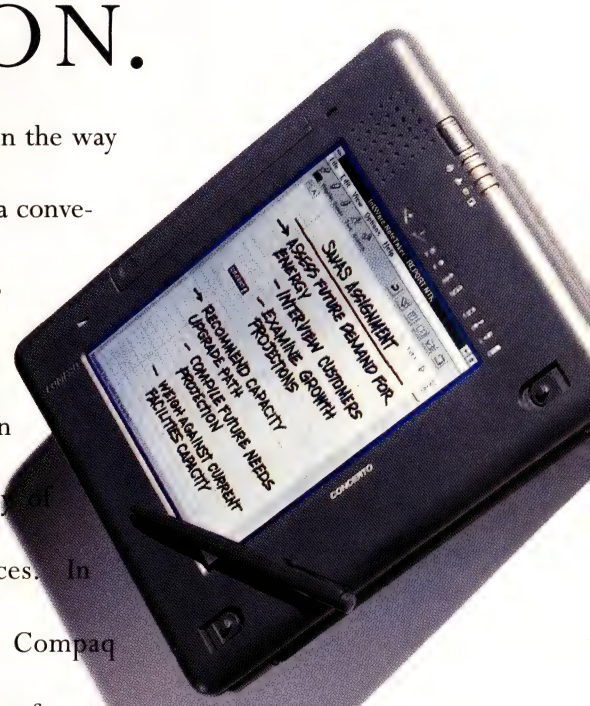


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matches one of its commands, the TSR must load AL with 0FF hex and return. If the command does not match, the TSR should pass the interrupt on to the program that previously hooked the multiplex interrupt by jumping to the location pointed to by the old multiplex vector.

Thus, in greater detail, when the user enters a command, COMMAND.COM parses the first word of the command, capitalizing it and padding the command with spaces up to the 8-character limit. COMMAND.COM then performs its multiplex interrupt call, with AX equal to AE00 hex and DX loaded with 0FFFF hex. The combination of DS and BX point to a buffer that contains the original command line. The first byte in the buffer is the length of the buffer; the second byte contains the length of the command line. The command line itself follows the length bytes and is terminated by a carriage return (0D hex) character. DS:SI contains a pointer to the formatted command. The first byte in this buffer is the length of the command and is followed by the capitalized and padded command itself.

When a program tells COMMAND.COM, "Hey! That's *my* command!," COMMAND.COM again calls the multiplex interrupt, this time with AX equal to AE01 hex. The result is that although DS:SI points to the formatted command, there is no pointer to the original unformatted command line, which the TSR should save.

The program that originally claimed the command should now execute it. When complete, the executing program should then zero the size byte in the command buffer; otherwise, COMMAND.COM will attempt to execute the command in this buffer when it returns. When QPATH claims a command that it finds on its "to be disabled" list, it simply sets the size byte to zero right away instead of executing the command and then setting the size byte to zero.

While this completes our discussion of the way the command notification hook works, following the process along a little further is relevant to QPATH's operation. If no TSR claims a command, then COMMAND.COM compares the name of the command against its list of internal commands. If no match is found, COMMAND.COM performs a search in the current directory for a matching file name with a .COM, .EXE, or .BAT extension.

Contrary to popular belief, COMMAND.COM does not specifically search for a file with a .COM extension first. Instead, COMMAND.COM performs a search for any file with the matching filename. If the search is successful, the extension of the found file is checked to see if it is .COM, .EXE, or .BAT. If not, the search continues until a file is found with one of these extensions or until no more matching files are found. If a file is found with an .EXE extension, the search continues in order to ensure that there is no .COM file with the matching filename in the same directory. If a matching .BAT file is found, the search continues for a .COM or .EXE file. This search method is much faster than conducting three searches of the directory for a specific .COM, .EXE, or .BAT file.

QPATH manipulates COMMAND.COM into loading the program from one of the QPATH directories instead of looking first in the current directory.

If COMMAND.COM does not find a file in the current directory, then it searches each directory listed in the PATH environment variable. In each directory, it uses the same search method that it uses in the current directory. If COMMAND.COM finally finds a file, it uses the DOS EXEC function to launch the program.

INSIDE QPATH Now that we've seen how COMMAND.COM allows TSRs to change or add to its command list, it's time to explore QPATH directly. QPATH does not add any commands to COMMAND.COM. Rather, as you'll see, it uses the notification to find out when COMMAND.COM is about to execute a program. QPATH then manipulates COMMAND.COM into loading the program from one of the QPATH directories instead of looking first in the current directory.

As with all TSRs, QPATH's code can be divided into two parts: a transient portion that is executed when the utility is installed and a resident portion that runs after the program has been installed. The transient portion handles the initialization tasks necessary to install QPATH. First, the transient code checks the DOS version to ensure that QPATH is running under DOS 3.3 or a later version. Next, it checks to see whether a copy of QPATH is already installed in memory.

Over the years, TSRs have used many different techniques to determine whether a copy of a program has already been installed. For programs that must run under DOS 2.*x*, the best way is to examine each of the allocated memory blocks in conventional memory to find one loaded with the program. Although this method works well for early versions of DOS, the advent of upper memory blocks and the High Memory Area (HMA) has rendered it unreliable. For TSRs running under DOS 3.0 or later, the best way to locate installed code is to use the multiplex interrupt.

DOS uses the multiplex interrupt for a variety of communication tasks that can be divided into two general uses: adding functions and providing notification of events. As you have seen, COMMAND.COM uses the multiplex interrupt in the latter capacity to notify other programs that it is about to execute a command. Similarly, Windows uses the multiplex interrupt to tell programs that it is starting or terminating. On the other hand, programs such as PRINT use the multiplex interrupt to add new functions to DOS. Once PRINT is installed, any program can control PRINT's list of files to print by using the multiplex interrupt. Other TSRs can add functions of their own via the multiplex interrupt, and the most popular of these is an "Install check" function.

The protocol governing a program's use of the multiplex interrupt dictates that when the multiplex interrupt is called, a number identifying the program

FINDPROG
Complete Listing

```
;-------------------------------------------------------------
; FINDPROG - searches a directory for a COM EXE or BAT file.
; Entry: Program name loaded in working buffer.
;        ES:DI pointing to end of filename.
; Exit:  AL = 0 if file found
;-------------------------------------------------------------
findprog        proc    near
                assume  cs:code,ds:code,es:code
                push    bp
                mov     bp,di
                cmp     extflag,0               ;See if extension needed
                jne     findprog_1
                mov     ax,'*.'                 ;Append .*
                stosw
findprog_1:
                xor     ax,ax                   ;Terminate filename
                stosb

                lds     dx,buff_ptr             ;DS:DX ptr to filename
                mov     cx,7                    ;Look for all files
                mov     ah,4Eh                  ;Find first file
                int     21h
                jc      findprog_exit
                cmp     extflag,0               ;See if ext specified
                jne     findprog_6
                xor     cx,cx                   ;Clear file found flag
findprog_2:
                mov     si,offset exts
                mov     di,DTAPTR+1Eh           ;Point to found extension
                mov     ah,'.'
                call    findchar
                dec     di
findprog_21:
                push    di
                mov     bx,si                   ;Compare extension
                cmpsw                           ;  found to allowable
                jne     findprog_3              ;  extensions.
                cmpsw
findprog_3:
                pop     di
                je      findprog_4              ;Cmp ext to last found.
                mov     si,bx
                add     si,4
                cmp     byte ptr [si],0
                jne     findprog_21
                jmp     short findprog_41       ;no more exts, search.
findprog_4:
                cmp     cx,bx                   ;See if higher priority
                ja      findprog_41             ;  than prev found prog.
                mov     cx,bx
findprog_41:
                mov     ah,4fh                  ;Find Next file
                int     21h
                jnc     findprog_2
findprog_5:
                or      cx,cx                   ;See if prog files found.
                stc
                je      findprog_exit           ;No, punt.
                mov     si,cx
                mov     di,bp                   ;Get ptr to end of name
                movsw                           ;Append found extension.
                movsw
                xor     al,al                   ;Set found flag and
                stosb                           ;  terminate filename
findprog_6:
                clc
findprog_exit:
                pop     bp
                ret
findprog        endp
```

Figure 2: **QPATH uses the FindProg routine to search directories for a program.**

is to be loaded in AH and the function number is to be loaded in AL. DOS reserves program numbers—which are are sometimes called Device IDs—0 to BF hex. This leaves IDs from C0 to FF hex for use by TSRs. With the exception of function 0, which is reserved as an install check, programs are free to assign any function to the value in AL.

To determine whether a program with a particular device ID is loaded, a call is made to the multiplex interrupt with the device ID in AH and zero in AL. If a program with the corresponding Device ID is installed, it should return with AL set to a nonzero value.

To check for a previously installed copy of itself, QPATH successively calls the multiplex interrupt with Device IDs, starting with 0DB hex. I start my multiplex searches at DB becase those are my initials. Further, 0DB is far enough above 0C0 for me to know that TSRs having DB, DC, DD, (and so on) multiplex IDs are usually mine.

If the call returns with AL nonzero, it means that there is an installed program using that ID. This does not necessarily mean that the program is another copy of QPATH, however. To determine whether the responding program is QPATH, the segment that ES points to is compared with the QPATH program. If the start of the two segments match, then the installed program is QPATH. If there is no match, the multiplex interrupt is called again with the next ID. This process continues until either QPATH is found or an unused ID is found, indicating that QPATH is not installed.

The FindInstalled routine that QPATH uses to locate a previously installed copy is shown in Figure 1. Note that if no already resident copy of QPATH is found, and if there is at least one unused multiplex ID, the variable "multiplex_id" ends up holding the value of the first unused ID. This value is used by subsequent parts of the program.

Once QPATH has determined whether it has been previously installed, it parses the command line. Parsing the command line involves finding any command line switches, which are indicated by the forward slash (/) character. When a slash is found, the character immediately following is compared to a list of allowable command switches. If found, the offset in the list of switches of the matching character is used as an index into a jump table that contains the offsets of the routines that process each of the switches.

The routines for the enable and disable functions are simple. First, an enable flag is set or cleared, depending on the command. Then, if QPATH has been previously installed, the installed code is enabled/disabled using a multiplex command. The Device ID used is the ID that was found by the FindInstalled routine, as discussed above.

The Remove routine uninstalls a previously installed copy of QPATH. Before the program can be removed from memory, the interrupt vectors for interrupts 21 and 2F must be checked to ensure that they have not been modified after QPATH's installation. If the interrupt vectors have been modified, QPATH does not attempt to uninstall and instead displays a "Can't Uninstall" message. If the interrupt vectors are unmodified, they are replaced with the vectors previously stored in the segment of the installed code. The segments of the installed code and environment are then freed, removing QPATH from memory.

The Exclude command line switch causes QPATH to parse the command



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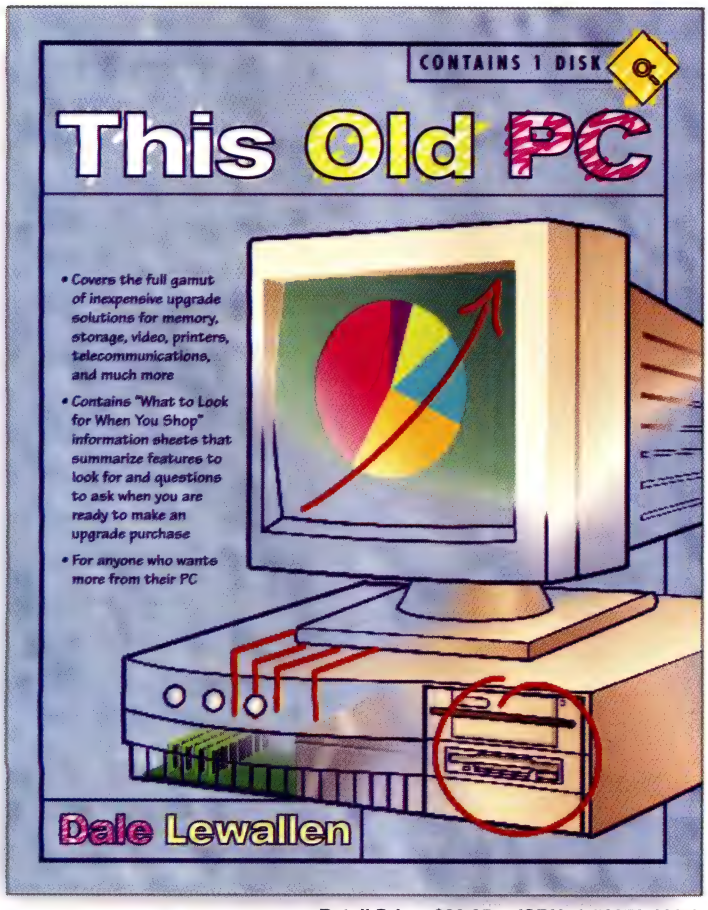
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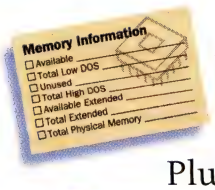
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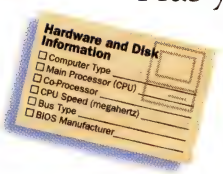


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line, looking for commands to disable. The commands are capitalized and added to a list located in a buffer beyond the end of the transient code. Each element of the list consists of a byte containing the length of a command, followed by the command itself. The list is terminated with a zero byte immediately following the last command.

As with most TSRs, installing QPATH involves replacing the appropriate interrupt vectors, computing the necessary memory requirements, and performing the Terminate and Stay Resident DOS function. QPATH redirects two interrupts, the DOS function dispatcher (Interrupt 21h) and the multiplex interrupt (Interrupt 2Fh). The resident memory size includes the size of the PSP, the code, and buffers for the disable command list and DTA. After redirecting the interrupts and computing the memory size, the Install routine jumps to a short final install stub that is located in the resident portion of the code. This short routine copies the list of disabled commands to a location immediately following the last byte of the resident code. The final Install routine must be located in the resident code since the disable commands list is copied over the transient code. The installation is completed by the TSR command to DOS.

QPATH RESIDENT CODE The main job of the resident code is to monitor the multiplex interrupt for a command notification from COMMAND.COM. When such a notification is detected, the resident code must perform two tasks: It must check for any commands to be disabled, and it must see if the program name matching the command resides in one of the QPATH directories.

When QPATH detects a command notification, it compares the formatted command (which is pointed to by DS:SI) with the list of commands to be disabled. To speed the comparison, QPATH first checks the length of the command to the length of each entry in the disable command list. Only the entries that are the same length as the command need to be compared.

If QPATH finds the command in the disable commands list, it sets a flag and returns to COMMAND.COM with AL set to 0FF hex, indicating that QPATH will accept the command. COMMAND .COM then calls the multiplex interrupt again to tell QPATH to execute the command. Instead of executing the command, QPATH simply zeros the length byte of the buffer pointed to by DS:SI and returns to COMMAND.COM. For its part, COMMAND.COM assumes that QPATH has executed the command and so takes no further action.

Checking for programs in the QPATH directories is a bit more involved than simply disabling commands. When COMMAND.COM sends out its command-pending notification, QPATH examines the command to determine whether a path has been specified with the command. A path specification is denoted either by a colon (:) in the second character of the command, indicating that a drive has been specified, or by a backslash (\) somewhere in the program name, indicating that a directory has been specified. If a path has been specified, QPATH takes no action, since the user has specified a particular directory for the program. This allows the user to substitute same-named commands for those that QPATH excludes.

If, on the other hand, no directory was specified, QPATH must search each of the directories listed in the QPATH environment variable for a matching program name.

Before this search can take place, however, QPATH must make a partial save of the DOS state. Even with a program as simple as QPATH, which makes only a handful of DOS calls, a number of items must be saved. First, the state of the A20 line gate must be saved by calling the extended memory (XMS) driver. The A20 line gate is a programming relic from the old 8088 days that allowed the real mode address to wrap around to the low addresses when set (for an 8088, which had no actual A20 address line) and allowed access to the HMA (for a 286) when clear.

Next, the extended error information must be saved, and the vectors of the break, Ctrl-C, and critical error interrupts must be redirected to internal routines. These actions prevent any errors that QPATH causes from being reflected back to COMMAND.COM. Finally, QPATH saves the active PSP and Disk Transfer Area (DTA) pointer.

Since the QPATH directories are specified by the QPATH environment variable, the active environment must be located so that the variable can be retrieved. Fortunately, finding the active environment is trivial in this particular case. Since the command notification is called from COMMAND.COM, you simply need to use the environment pointer in the formerly active PSP, which of course is COMMAND.COM. In DOS 3.3 and in later versions, the word at offset 2Ch in COMMAND.COM's PSP is the segment address of its environment. In DOS 3.2 and earlier versions, however, COMMAND.COM's environment is found instead in the memory block immediately following COMMAND.COM, and the Word at 2Ch in its PSP is irrelevant (and usually 0).

QPATH finds the QPATH environment variable by comparing QPATH with the name of each variable in the environment. An environment block is organized into several ASCIIZ strings, each having a *name=data* format. The list of variables is terminated with an additional zero byte. QPATH thus checks for the string QPATH= at the start of the first variable. If there is no match, the program finds the terminating zero of the variable and looks at the next variable. This process continues either until QPATH= is found or until two zeros are found in a row, indicating the end of the variable list.

If a QPATH variable is found, each directory in the QPATH is searched for a file that has either a .COM, .EXE, or .BAT extension. The Findprog routine that performs this search is listed in Figure 2. Findprog uses the same search process as COMMAND.COM, searching for any file with the matching filename, then comparing the extension found to the allowable list of .COM, .EXE, and .BAT. If the user specified an extension with the command, that extension is used instead.

If QPATH finds a matching file, it tricks COMMAND.COM by substituting its QPATH variable for the PATH environment variable. QPATH then causes COMMAND.COM's initial search of the current directory to fail by setting the carry flag and returning a "No

more files" error code. Once COMMAND.COM has launched the program (or, in the case of .BAT files, allocated memory for the .BAT data segment), QPATH restores the PATH and QPATH variables to their previous state.

The only other task left for the resident code is fielding any multiplex commands sent by another copy of QPATH. QPATH has four multiplex commands: Check Installed, Enable, Disable, and Get Enabled State. The Check Installed function sets ES to the installed code segment and returns with AL loaded with 0FF hex. The Enable function sets the enable flag in the resident code and then returns. Conversely, the Disable function clears the enable flag and returns. Finally, the Get Enabled State returns the value of the enable flag in DL.

QPATH is a simple, yet handy utility that demonstrates the use of the command notification hook in COMMAND.COM. And when you use QPATH, DOS will spend less time rummaging through your current directory and more time doing real work. □

DOUGLAS BOLING IS A CONTRIBUTING EDITOR OF *PC MAGAZINE*.

GUIDE TO OUR UTILITIES & HOW TO GET THEM

QPATH

PURPOSE: A small TSR (Terminate and Stay Resident) utility that directs DOS to begin its search for a command with a given path rather than with the current directory, and which prevents DOS from executing specified commands.

FORMAT: `QPATH [/D] [/E] [/U] [/X cmd[, ...]]`

REMARKS: Entering QPATH at the command prompt installs the utility, which requires slightly more than 1K of RAM. On 386 and 486 machines, QPATH may be loaded in high memory by using the LOADHIGH command of DOS 5.0 or the equivalent command of memory managers such as 386MAX. The DOS SET command is used to assign the string indicating the path to be initially searched to the environment variable QPATH. The path string can be changed from the DOS prompt at any time.

The optional /X switch precedes one or more commands, separated by commas, which are to be disabled. To change the list of such commands requires uninstalling and reinstalling QPATH. If desired, a command with the same name as the one that is excluded from execution can be run via a DOSKEY macro or by specifying the full path with the command.

The /D switch may be used to disable QPATH, restoring normal DOS operation. The /E switch will enable QPATH once again. If no TSRs that use Interrupts 21h or 2Fh have been loaded after QPATH's installation, QPATH can be uninstalled by using the /U switch.

QPATH requires DOS 3.3 or later; it is known to be incompatible with DESQview. The executable and assembly-language source code for the utility can be downloaded from PC MagNet or requested on disk from *PC Magazine* as outlined in the original article.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

PCs

UPGRADING MOTHERBOARDS

❓ I would like to upgrade the motherboard on my 386 computer to a 486. I also want local-bus compatibility and the ability to upgrade to the new Pentium chip. Can you recommend a high quality motherboard that meets these requirements? It's difficult to know what to buy, since *PC Magazine* doesn't review motherboards as separate products.

Maxim Spivak
San Francisco, California

▶**PC MAGAZINE:** While your goals are laudable, you're not going to find any product that meets all your needs.

Like the 386, the 486 chip uses a 32-bit system bus. The VESA VL-Bus is the local-bus standard of choice and is also designed for a 32-bit system. (The Intel PCI bus, which hasn't yet reached the market, is also designed for a 32-bit bus.) In contrast, the Pentium is designed with a 64-bit system bus. As a result, if a motherboard is to take full advantage of this chip, it will have to be designed for the 64-bit bus and for new 64-bit local-bus standards. Since adding these features to a 486 system is an unnecessary expense (and extra expense translates into a competitive disadvantage), you're not likely to find a 486 motherboard of this type.

Intel has announced plans for a 32-bit version of the Pentium, known as the P24T. But whether you will be able to add it to existing 486 motherboards and, if you can, just how much of a performance increase you get remain to be seen. The P24T won't be available until 1994 at the earliest, and even then the 32-bit system bus means that you won't be able to realize the full performance potential of the Pentium design. Your best bets are to either sit tight and wait for the Pentium systems to arrive in sufficient quantities to make them competitively priced or to build a 486 system now with the intention of replacing the motherboard again in a year or two.

As for which motherboard to buy, you're correct that *PC Magazine* doesn't review motherboards as a product category, even though we do review other components, such as video cards and disk controllers. One reason for this is that the majority of our readers replace systems rather than upgrade motherboards, since they often have to replace other components to take full advantage of the new system's performance potential. Our system reviews frequently mention the motherboard manufacturer, however, so you can use them to build a short list of candidates to use in your upgrade plans.—*Alfred Poor*

Operating Environments

PROTECTING WINDOWS SETUP

❓ In our school district, we installed Windows on a number of PCs, setting them up permanently—we thought—for use as research machines that would provide access to various multimedia reference works. We found, however, that we need to prevent students from using Program Manager menus to reconfigure the computers. Is there a simple way to place passwords on these menu items or at least disable any that might be dangerous?

John R. Oetting
Lake Lotawana, Missouri

▶**PC MAGAZINE:** Password protecting Program Manager would be quite a project! Fortunately, it's one you can skip, since you can restrict the changes others can make from Program Manager merely by setting certain key values in PROGMAN.INI. Of course, if *you* need to make changes afterward, you'll have to modify PROGMAN.INI and restart Windows—but that's a small price to pay for security.

To begin the process, load PROGMAN.INI into Notepad (or your favorite text editor) and search for the string [Restrictions]. (If—as is likely—you don't find it, go to the end of the file and add the string on a line by itself, making sure to include the square brackets.) Placing any of five different key values in the [Restrictions] section allows you to dictate the actions Program Manager will block. Inserting the line `NoRun=1`, for example, disables the Run command on the File menu—forcing users to start programs

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PC DIRECT

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"I'd rather stick needles in my eyes than talk to one of those techno-wannabees who thinks a bus is some form of public transportation."



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strictly from icons. Add `NoClose=1` and your students will no longer be able to exit Windows (probably not a good idea, since this also keeps *you* from exiting). `NoSaveSettings=1` prevents any changes a user does manage to make from being saved when Windows shuts down. Specifying `NoFileMenu=1` removes the entire Program Manager File menu, leaving users unable to add, delete, move, or modify icons within groups. Any of these four restrictions can be removed at a later time either by setting the key to 0 instead of 1 or by deleting the key entirely.

The fifth key, `EditLevel=`, lets you fine-tune the selection of modifications allowed under File | Properties. You can set the key to any value from 0 (the least limiting) to 4 (the most limiting). Each number includes all the restrictions of the preceding number. `EditLevel=0`, the default, allows all changes. `EditLevel=1` thwarts any modification (creation, deletion, or renaming) of groups. It prevents the Program Object dialog—where you choose whether to alter a group or a program item—from appearing when you select File | New. `EditLevel=2` causes the New, Delete, Copy, and Move selections under the File menu to gray out, keeping users from creating, removing, or duplicating program items or shuffling them to different groups. `EditLevel=3` prevents changes to the program item command line in the Program Item Properties dialog (which appears when you select File | Properties). Finally, `EditLevel=4` allows no alterations to program item properties, although you can still view them.

Since your aim is to prevent changes to Program Manager groups once you've set them up, you'll want to use either `NoFileMenu=1` or `EditLevel=4`. If you choose the `EditLevel` route, you'll also want to set `NoRun=1`. Eliminate NOTEPAD.EXE, WRITE.EXE, and any other programs that would allow students to modify PROGMAN.INI, then restart Windows to make the changes take effect. When *you* need to make changes in Program Manager's layout, exit Windows and use a text editor to zero out the key values under [Restrictions]. Restart Windows, make your changes there, then exit and restore the restrictions.—*Neil J. Rubenking*

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Word Processing

A FONT OR PICTURE CATALOG FOR WINWORD

TIP The font-printing utility, FNTPRN, in the Utilities column in your issue of April 13, 1993, will let you print samples of all the fonts installed in Windows, but it's limited to Windows Write format. By coincidence, before reading that issue I had just completed a macro for doing the same thing in Microsoft Word for Windows. The macro (Figure 1) uses a For. . .Next loop to go through the list of available fonts. For each font, the macro inserts a one-line sample that reads

```
This is a font demo for the font x
```

where *x* is the name of the font.

Figure 2 shows a similar macro for producing a clip-art reference. This macro will find all the picture files in a given subdirectory, insert them into a

WinWord file, and label each picture with the path and filename. In my office, where we have over 300 pictures available in 11 different directories, the resulting printout has proven invaluable.

G.L.B.
Wichita, Kansas

▶PC MAGAZINE: Both of these macros can be quite useful. One clear advantage the WinWord macro has over FNTPRN is that you can easily create any sample text by entering the text as part of the Insert command. I created a version (Figure 3) that, for example, produces font samples with all upper- and lowercase letters, the numbers 0 to 9, and most of the characters on the IBM-PC keyboard.

Both versions of the macro use the CountFonts() function to determine the number of fonts available, and control how many times to run through the For. . .Next loop, counting from 1 to the number of fonts. Each also uses Font$ (count) to set the value of the variable FontStyle$, and each uses FormatCharacter to set the current font as the macro steps through the list of fonts. Note too how each uses the Insert command to insert text, and the InsertPara command to end each line. Figure 3 adds an extra InsertPara command to insert a blank line between font samples.

One shortcoming of the macro in Figure 1 is that it won't print the name of fonts that don't have alphabetic characters, such as Symbol or Wingdings. The NewFontSample solves this by creating the variable BaseFont$ before the For. . .Next loop, and setting it equal to the font the cursor is on. On each pass through the loop, it uses the FormatCharacter command to first set the font to the BaseFont$, and then uses that starting font to print the name of the current font, with the command

```
Insert FontStyle$ + " Font"
```

Only then does the macro set the current font to FontStyle$ and print the sample. Before using this macro, make sure you're set for an appropriate font for the BaseFont$.

The macro in Figure 2 takes much the same form as the font generation macro, but uses different commands. Once again, the heart of the macro is a For. . .Next loop. In this case, the macro uses CountFoundFiles() to determine the number of files, and, therefore, the number of times to go through the loop.

FontSamples
Complete Listing

```
Sub MAIN
For count = 1 To CountFonts()
   FontStyle$ = Font$(count)
   FormatCharacter .Font = FontStyle$
   Insert "This is a font demo for the font "
   Insert FontStyle$
   InsertPara
Next
End Sub
```

Figure 1: **This WinWord macro will create a sample line in each font available on your system.**

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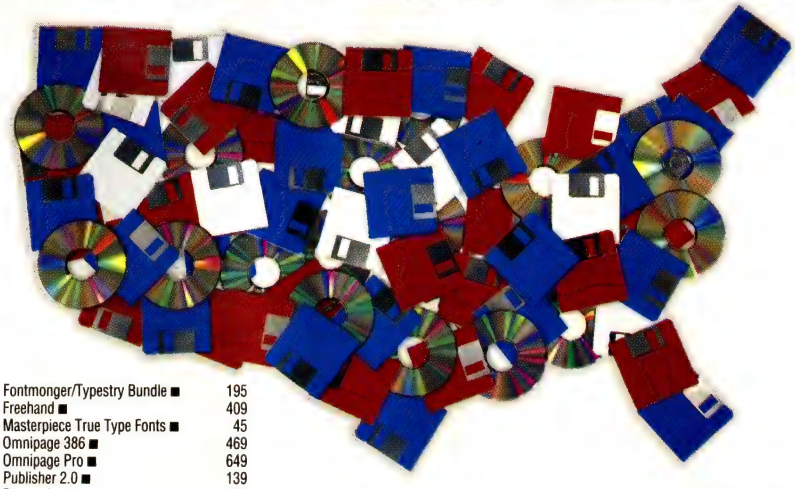
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PixSamples
Complete Listing

```
Sub MAIN
PixPath$ = InputBox$("Type in the path to search:"
FileFind .Title = "", .Subject = "", .Author = "", .Keywords = "", .SearchPath
= PixPath$ + "\*.*"
If CountFoundFiles() = 0 Then
Goto EndRoutine
Else
For count = 1 To CountFoundFiles()
Pix$ = FoundFileName$(count)
InsertPicture .Name = Pix$, .LinkToFile = 0
InsertPara
Insert "This picture is in the file "
Insert Pix$
InsertPara
Next
EndRoutine:
End Sub
```

Figure 2: **This WinWord macro will create a reference document of images on-disk, inserting each picture from a given directory, along with the path and filename.**

NewFontSample
Complete Listing

```
Sub MAIN
BaseFont$ = Font$()
For count = 1 To CountFonts()
   FontStyle$ = Font$(count)
   FormatCharacter .Font = BaseFont$
   Insert FontStyle$ + " Font"
   InsertPara
   FormatCharacter .Font = FontStyle$
   Insert "ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890"
   InsertPara
   Insert "abcdefghijklmnopqrstuvwxyz"
   InsertPara
   Insert "! @ #$ % ^ & *() _ + - = { } [ ] :  ;<>?,./¦\~`"
   InsertPara
   InsertPara
Next
End Sub
```

Figure 3: **Much like the macro in Figure 1, this macro will print sample output for each font available in Windows, using a more inclusive sample. In addition, it will print the name for all fonts—including Symbol, Wingding, and other fonts that lack alphabetic characters.**

The macro then uses the FoundFileName$(count) function to set the value of the variable Pix$, the InsertPicture command to insert the picture defined by Pix$, and the Insert command to add a label, including the current value—meaning the drive, directory, path, and filename of Pix$.

The commands before the loop are reasonably straightforward. The macro first sets the value of the variable PixPath$ by asking for the path to search, using the InputBox$ function. The macro then uses the PixPath$ variable to set the SearchPath in FileFind. If the FileFind command doesn't find any files, so that the CountFoundFiles() function is 0, the macro will then jump to the EndRoutine label. Otherwise the macro goes to the For. . .Next loop.

Note that there are several assumptions built into this macro—and more limitations than we have room to adequately deal with here. Most important, the macro assumes you will know the full pathname for the directory to use. And by ending the search path with the wildcard designation *.*, it assumes that all the files in that directory are picture files. If those assumptions won't work for the way you store your picture files, you may want to delete the two lines between `Sub MAIN` and `If CountFoundFiles()=0`, and replace them with

```
Dim PixFiles As FileFind
GetCurValues PixFiles
Dialog PixFiles
```

These lines will, in essence, call up the FileFind dialog box, and let you enter the path and filenames (such as *.bmp) you want to include. The macro will then use those entries. Note that this approach will not work if you try entering more than one active path in FileFind, however.

Another alternative that you might find useful—particularly if you keep all your picture files in one or two directories—would be to include the directory name in the macro. For example, you can change the second line in the macro to

```
PixPath$ = InputBox$("Type in the
 path to search:",,"c:\winword\clipart")
```

With this version of the command, the dialog box will pop up with the path C:\WINWORD\CLIPART already entered. And you can then accept or change it. This approach would also be useful if you have several subdirectories of picture files in a single picture directory. To go to the proper directory, you would only need to add the subdirectory name to the end of the default entry.

You can download all three macros from PC MagNet, archived as FONPIX.ZIP.—*M. David Stone*

Databases

NUMERIC DAY OF THE YEAR

TIP I have often been asked how to calculate the numeric day of the year (1 to 365, or 1 to 366 in leap years). The FoxPro function d2jul() (shown in Figure 4) returns the day number as a three-character numeric string. If you pass it a date, it returns the day number for that date. If you do not pass a date parameter, it returns the day number for the current date as returned by the DATE() function.

Al Smith
Redmond, Washington

▶PC MAGAZINE: This is sometimes referred to as the *relative Julian date* or *relative Julian number* (see Databases, April 28, 1992). I took the liberty of consolidating Mr. Smith's d2jul() function into the ndy() function (Figure 5). The ndy() executes faster, because it is much shorter and FoxPro has fewer lines to interpret.

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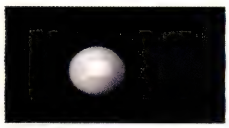
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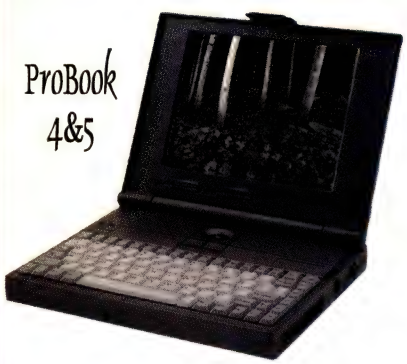
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The d2jul() Function
Complete Listing

```
*********************************************************************
* FUNCTION d2jul
* Returns a character string of length 3, left padded with zeros
* reflecting the number of the day of the year: 001 to 365 or 366.
*********************************************************************
FUNCTION d2jul
PARAMETER adate
lcyearset=SET("CENTURY")
SET CENTURY ON
lcdatedisp=SET("DATE")
SET DATE TO ANSI
IF PARAMETERS()=0
   bdate=DATE()
ELSE
   bdate=adate
ENDIF
startjulian=CTOD(STR(YEAR(bdate)-1)+".12.31")
miljulian= PADL(LTRIM(STR(bdate-startjulian)),3,"0")
SET CENTURY &lcyearset
SET DATE TO &lcdatedisp
RETURN miljulian
```

Figure 4: **This FoxPro function accepts a date (or uses the current date if none is passed) and returns the number corresponding to that date's position in the year.**

The ndy() Function
Complete Listing

```
*********************************************************************
* FUNCTION ndy
* Returns a character string of length 3, left padded with zeros
* reflecting the number of the day of the year: 001-365 or 366.
*********************************************************************
FUNCTION ndy
PARAMETER d
boy = CTOD("01/01/"+LTRIM(STR(YEAR(IIF(EMPTY(d),DATE(),d)))))
RETURN PADL(LTRIM(STR((d - boy) + 1)),3,'0')
```

Figure 5: **This is a shorter and quicker version of the function in Figure 4.**

Both use FoxPro's ability to calculate the number of days between two dates.

The d2jul() function works by subtracting the last date of the previous year (12/31/*yy*) from either the date passed to the function or, if no date is passed, from today's date as returned by the DATE() function. The result is the day number, which is then converted to a string and left-padded with leading zeros.

The ndy() function works similarly, except that the first of the year is used as the base date instead of 12/31 of the prior year. This is subtracted from the date passed to the function, or, if no date is passed, from today's date as returned by the DATE() function. Then 1 is added to the result to come up with the day number, which is then converted to a string and left-padded with leading zeros.

You can download the functions mentioned here from PC MagNet, archived as D2JUL.ZIP.—*Sal Ricciardi*

Languages

AN ASSEMBLY LANGUAGE WINDOWS PROGRAM

❓ The first—and simplest—program you learn in any language usually involves displaying the message "Hello World" on the screen. I can do this several different ways in assembly language running under DOS. My impression of Windows programming is that it is similar to DOS programming, except that programs are written in C with calls to Windows' API rather than in assembly language using interrupts. Could you please write a simple Windows program to display the message "Hello World" in assembly language?

Kirk Becker
Austin, Texas

▶PC MAGAZINE: Windows programs are generally written in C for a number of reasons. First and foremost, C is a compiled language that provides good performance, even though it's a step removed from assembly language. Also, the Windows API was designed to be called from a high-level language. When a program calls a DOS function, the program uses registers to pass information; a Windows program pushes the parameters on its stack, and then calls the appropriate Windows function. Finally, what has really turned C into the language of choice for Windows programmers is that C is the only high-level language originally supported by the Windows Software Development Kit (SDK). While other languages now support Windows development, C has always been recommended by Microsoft.

Microsoft does, however, provide the necessary include files to write a Windows program in assembly language. And there are certain tasks for which assembly language can be quite useful in Windows programs. Portions of code that require maximum speed or minimum size are ideal candidates for assembly language. All of the major C compilers support both in-line assembly and calls to assembly language routines.

It is rare for an entire Windows program or DLL to be written in assembly language. As I show below, the gains in size or speed are minimal for most of the standard tasks a Windows program must perform. Most tasks performed by a Windows program (such as creating windows, processing messages, and reacting to input from the user) are accomplished by calls to the Windows API. Since parameter passing is stack-based, the C compiler generally just reduces the C source down to a series of pushes onto the stack and a far call to Windows.

In spite of all the preceding observations, it *is* occasionally nice to see how things really work. Assembly language is the best way to see what's really happening. I took an example from Chapter 2 of Charles Petzold's classic *Programming Windows* (Microsoft Press, 1992) and translated it into assembly language. The result of this translation, called WINASM.ASM, is shown in Figure 6.

While many assemblers provide

WINASM.ASM

1 of 2

```
    name    WinAsm
    page    60,132
    title   WINASM.EXE--Sample Windows assembly language program
;
; WINASM.EXE: demonstrates a simple Windows program written
;             in assembly language.
;
; Copyright 1993, Douglas Boling
;
memS    =   1               ;Define Small Model program
?PLM    =   1               ;Define Pascal calling convention
?WIN    =   1               ;Define Windows prolog and epilog code
?386    =   0               ;Don't use 386 instructions

include CMACROS.INC         ;Required Windows includes
include WINDOWS.INC
;
; Windows APIs used by program
;
externA  __acrtused
;
; Windows APIs used
;
externFP        LoadIcon
externFP        LoadCursor
externFP        RegisterClass
externFP        CreateWindow
externFP        ShowWindow
externFP        UpdateWindow
externFP        GetMessage
externFP        TranslateMessage
externFP        DispatchMessage

externFP        BeginPaint
externFP        GetClientRect
externFP        DrawText
externFP        EndPaint
externFP        PostQuitMessage
externFP        DefWindowProc
;
; External entry points to the program
;
public          WinMain
public          WndProc
;
; Code segment
;
_TEXT   segment word public 'CODE'
        assume  cs:_TEXT,ds:_DATA
        .8086
;--------------------------------------------------------------
; WinMain - Standard Windows program entry point
;--------------------------------------------------------------
hInstance       equ     word ptr ss:[bp+12]
hPrevInstance   equ     word ptr ss:[bp+10]
lpCmdLine       equ     dword ptr ss:[bp+6]
nCmdShow        equ     word ptr ss:[bp+4]

hWnd            equ     word ptr ss:[bp-4]

WinMain proc    near
        push    bp
        mov     bp,sp
        sub     sp,4                    ;Make room for local variables
        push    di
        push    si

;cProc  WinMain, <PUBLIC>, <DI,SI>
;       parmW   hInstance
;       parmW   hPrevInstance
;       parmD   lpCmdLine
;       parmW   nCmdShow

;       LocalW  hWnd                    ;Local variables


;cBegin WinMain
;
; If only instance running, Register the Window class
;
        cmp     hPrevInstance,0         ;See if we need to register the
        jne     WinMain_1               ;  window class.

        mov     wc.clsStyle,CS_HREDRAW OR CS_VREDRAW
        mov     word ptr wc.clsLpfnWndProc,offset WndProc
        mov     word ptr wc.clsLpfnWndProc+2,cs
        xor     ax,ax
        mov     wc.clsCbClsExtra,ax
        mov     wc.clsCbWndExtra,ax
        mov     ax,hInstance
        mov     wc.clsHInstance,ax
        push    hInstance               ;hInst for LoadIcon call
        mov     ax,offset AppName
        push    ds                      ;Ptr to Icon resource name string
        push    ax
        call    LoadIcon
        mov     wc.clsHIcon,ax

        xor     ax,ax
        push    ax                      ;hInst = 0 because we are loading
        push    ax                      ;  a stock object.  The second
        mov     ax,IDC_ARROW            ;  parameter is a 32 bit value.
        push    ax
        call    LoadCursor
        mov     wc.clsHCursor,ax
        mov     wc.clsHbrBackground, COLOR_WINDOW + 1

        xor     ax,ax
        mov     word ptr wc.clsLpszMenuName,ax
        mov     word ptr wc.clsLpszMenuName+2,ax

        mov     word ptr wc.clsLpszClassName,offset AppName
        mov     word ptr wc.clsLpszClassName+2,seg AppName

        lea     ax,wc
        push    ds
        push    ax
        call    RegisterClass
        or      ax,ax
        jne     WinMain_1
        mov     ax,1
        jmp     MainWinLoopExit
WinMain_1:
;
; Create the Window
;
        xor     bx,bx                   ;BX = 0 for NULL pushes
        push    ds                      ;Far Ptr to Class Name
        mov     ax,offset AppName
        push    ax
        push    ds                      ;Far Ptr to title text
        mov     ax,offset ttltext
        push    ax
        mov     ax,WS_OVERLAPPEDWINDOW  ;Window Style
        push    ax
        push    bx
        mov     ax,CW_USEDEFAULT
        push    ax                      ;Window Pos x
        push    ax                      ;Window Pos y
        push    ax                      ;Window Size cx
        push    ax                      ;Window Size cy
        push    bx                      ;Parent Window handle
        push    bx                      ;Menu handle
        push    hInstance               ;Program instance handle
        push    bx                      ;Far Ptr to Creation data
        push    bx
        call    CreateWindow

        or      ax,ax
        je      MainWinLoopExit
        mov     hWnd,ax                 ;Save Window handle

        push    ax                      ;Save hWnd for UpdateWin call

        push    ax                      ;hWnd
        push    nCmdShow                ;Show parameters
        call    ShowWindow

        call    UpdateWindow            ;hWnd already pushed
;
; The classic Windows message loop
;
MainWinLoop:
        lea     di,msg                  ;Use DI since that reg is
                                        ;  saved across Win calls.
        push    ds                      ;Far Ptr to Msg structure
        push    di
        xor     ax,ax
        push    ax                      ;Handle 0 -> all Windows
        push    ax                      ;Low msg num
        push    ax                      ;High msg num
        call    GetMessage
        or      ax,ax                   ;If WM_QUIT, do so.
        je      MainWinLoopExit
        push    ds                      ;Far Ptr to Msg structure
        push    di
        call    TranslateMessage
        push    ds                      ;Far Ptr to Msg structure
        push    di
        call    DispatchMessage
```

Figure 6: **A rarity—an assembly language Windows program. This one simply pops up a message box that says, "Hello Windows."**

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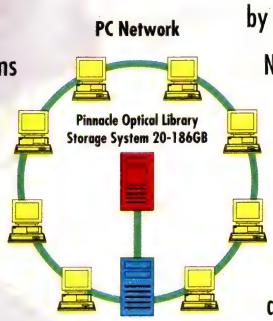


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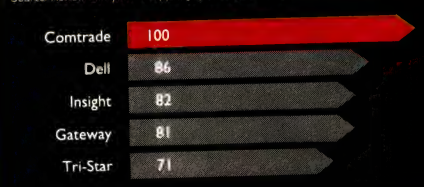
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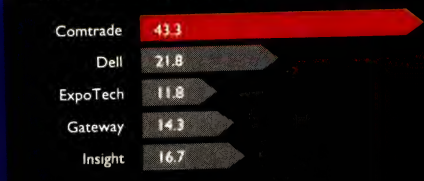
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WINASM.ASM

2 of 2

```
        jmp     short MainWinLoop
MainWinLoopExit:
        xor     ax,ax                   ;Set return code 0
MainExit:
        pop     si
        pop     di
        mov     sp,bp
        pop     bp
        ret
WinMain endp

;---------------------------------------------------------------
; WndProc - Main Window Callback Function
;---------------------------------------------------------------
hWnd    equ     word ptr ss:[bp+14]
wMsg    equ     word ptr ss:[bp+12]
wParam  equ     word ptr ss:[bp+10]
lParam  equ     dword ptr ss:[bp+6]
lParamh equ     word ptr ss:[bp+8]      ;Redef of lParam for word
lParaml equ     word ptr ss:[bp+6]      ;  addressing.

hdc     equ     word ptr ss:[bp-4]

WndProc proc    far

        mov     ax,ds                   ;Windows external entry point
        nop                             ;  code.  Necessary for all
        inc     bp                      ;  exported functions.  See
        push    bp                      ;  Petzold's chapter on memory
        mov     bp,sp                   ;  managment for details.
        push    ds
        mov     ds,ax
        sub     sp,2
        push    di
        push    si

;cProc  WndProc, <FAR,PUBLIC>, <SI,DI>
;       parmW   hWnd
;       parmW   wMsg
;       parmW   wParam
;       parmD   lParam
;
;       LocalW  hdc
;
;cBegin WndProc


        cmp     wMsg,WM_PAINT
        jne     WinProc_1
        push    hWnd                    ;Window Handle
        lea     ax,ps
        push    ds                      ;Far Ptr to PaintStruct
        push    ax
        call    BeginPaint
        mov     hdc,ax                  ;Save handle to DC

        push    hWnd                    ;Window Handle
        lea     ax,rectC
        push    ds                      ;Far Ptr to rect structure
        push    ax
        call    GetClientRect

        push    hdc                     ;Handle to DC
        lea     ax,HiText
        push    ds                      ;Far Ptr to text
        push    ax
        mov     ax,-1                   ;String length
        push    ax
        lea     ax,rectC
        push    ds                      ;Far Ptr to rect structure
        push    ax
        mov     ax,DT_SINGLELINE OR DT_CENTER OR DT_VCENTER
        push    ax
        call    DrawText

        push    hWnd                    ;Window Handle
        lea     ax,ps
        push    ds                      ;Far Ptr to PaintStruct
        push    ax
        call    EndPaint
        xor     ax,ax
        jmp     short WinProc_exit

WinProc_1:
        cmp     wMsg,WM_DESTROY
        jne     WinProc_2
        xor     ax,ax
        push    ax
        call    PostQuitMessage
        xor     ax,ax
        jmp     short WinProc_exit

WinProc_2:
        push    hWnd
        push    wMsg
        push    wParam

;       push    word ptr lParam+2
;       push    word ptr lParam

        push    lParamh
        push    lParaml
        call    DefWindowProc
WinProc_exit:
        pop     si                      ;Windows end procedure
        pop     di                      ;  code.
        lea     sp,ss:[bp-2]
        pop     ds
        pop     bp
        dec     bp
        retf    10                      ;Remove caller params
WndProc endp
;cEnd

_TEXT   ends

_DATA   segment word public 'DATA'

AppName db      'WinAsm',0              ;WinAsm Window class name
ttltext db      'ASM Program',0         ;WinAsm Window title bar text
HiText  db      'Hello Windows',0       ;WinAsm Window Text

wc      WNDCLASS        <>
rectC   RECT            <>
ps      PAINTSTRUCT     <>
msg     MSGSTRUCT       <>

_DATA   ends
        end
```

macro capability to simplify the programming effort required in assembly language, I feel that macros are counterproductive to this demonstration program, since they would hide the very details we're interested in seeing. Therefore, the only details hidden in the program are the offsets used by the structure references. For these, I have used the structure definitions in the WINDOWS.INC file provided in the Windows SDK. This file is also usually provided with compilers that support Windows programming.

Like a Windows program in C, the program is composed of a routine (WinMain) and a window procedure (WndProc). Using a different language does not change the basic architecture of a Windows program. The WinMain routine is called when the program is first loaded by Windows. Actually, WinMain is not the entry point of the program. Windows calls a predefined initialization routine that is used both by C programs and assembly programs. This initialization routine is included in the standard small-model Windows library that is combined with the program when it is linked. Because WinMain is called by a routine not in the .ASM file, it must be declared as a public label so that the linker can locate it.

WinMain is called from the initialization routine as it would be if the program were written in C, with the parameters pushed onto the stack. To provide addressability to the stack variables, BP is saved, and the current SP is copied into BP. This allows the stack variables to be addressed by using BP plus an offset. BP must first be saved, because the initialization routine calling WinMain also uses BP as a reference to its stack variables. The SDK also requires that DI and SI be preserved across the WinMain call.

While I don't have the space to provide a call-by-call description of WinASM, a discussion of the call to

CreateWindow() will be instructive. The call to CreateWindow() involves pushing a series of parameters onto the stack, and then making a far call to the function. There is really not much of a way to optimize pushing the parameters onto the stack beyond what can be accomplished by a good C compiler. Unlike DOS functions, Windows functions do not preserve the contents of all the registers across the calls. Only the contents of the BP, SI, and DI registers are preserved by Windows. While this is generally not a problem for high-level languages, pushing and popping a bunch of registers across calls to the Windows API can be a pain for an assembly language program.

For Windows functions that return values, word values are returned in the AX register, and double word values are returned in AX and DX. Since there is no abstraction of variables in assembly language, an assembly language programmer must know the size of all variables used in Windows. For example, instead of treating a window handle as some value of type HWND, an assembly language programmer must know that a window handle is a word value, not a double word or byte value. This also imposes the burden of knowing the size of constants that must be passed to functions. For example, in C a programmer can simply use the NULL constant for a parameter being passed to a function. The C compiler automatically uses either a zero word or double word for the parameter in question. In assembly language, the programmer must refer to the API reference in order to determine whether to push a word or a double word onto the stack for that parameter.

The design of the Windows API is tailored for use with high-level languages.

WinASM's performance is disappointing. Using assembly language instead of C doesn't reduce the size of the file much. In fact, because I placed some temporary variables in the data segment instead of on the stack, the executable file based on the ASM source is slightly larger than the C-based .EXE. Any performance gain yielded by converting such a simple program to assembly language is not noticeable on my machine.

"Real" hackers program in assembly language. For them, nothing is more satisfying than writing a tight assembly routine that can run rings around any of those inferior programs written in high-level languages. The design of the Windows API, however, is tailored for use with high-level languages. It's a bittersweet fact that assembly language does not have the preeminent position in Windows programming that it does in DOS programming.

You can download the source code and demonstration program files from PC MagNet's Programming Forum, archived in the file WINASM.ZIP.

—*Douglas Boling* □

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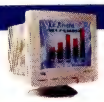
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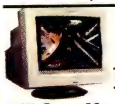
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Monochrome	005501 $1529	005516 $1769	005531 $1799
Dual-Scan Color	005506 $1999	005521 $2399	005536 $2449
Active-Matrix Color	005511 $2999	005526 $3299	005541 $3329

For an 80 Mb hard drive subtract $40. For a 200 Mb hard drive add $100. For a 340 Mb hard drive add $280.

*Battery life measured with Power Management enabled. Actual battery life may vary.

Elements:

Processor:
Intel 486SX-25, 486DX-33 or 486DX-50 SL-Enhanced upgradeable processor

RAM:
4 Mb, expands to 20 Mb

Hard Drive:
80 Mb, 120 Mb, 200 Mb or 340 Mb

Screen:
10", 640 x 480 VGA resolution
Backlit display
Color - 256 colors
Monochrome - 64 gray shades

Battery Life*:
Active-Matrix Color - 3 hours
Dual-Scan Color - 4 hours
Monochrome - 6 hours

Weight:
Color - 6.9 lbs.
Monochrome - 6.4 lbs.

512K DRAM plus 64K VRAM for turbo bus accelerated video technology

Simultaneous video on active-matrix and monochrome models

86 keys with 101-key emulation

Built-in trackball

Built-in 1.44 Mb, 3.5" floppy drive

Advanced Power Management

One parallel and one serial port

External VGA and keyboard connectors

One PCMCIA Type III slot/ two Type II slots

FREE AC adapter and utilities disk

FREE MS-DOS 6.0 installed

Brilliant Ideas Require Brilliant Performance

Elite 486SX-25 SubNote

Illustrate Your Points On This 10" Screen



You'd think a small 3.9 lb. SubNote would be hard to work on—but it's not. Elite's 486SX-25 SubNote delivers 640 x 480 VGA resolution on its 10" high-contrast screen so you can illustrate charts and graphs that are easy to read.
And unlike other notebooks that leave your wrists hanging, the Elite SubNote offers a built-in trackball and extended palm rest to support wrists.

But, that's not all! The Elite SubNote receives rave reviews for its special Intel SL-Enhanced processor that conserves power and extends battery life up to five hours when combined with Advanced Power Management.

For extra power take advantage of the SubNote's PCMCIA Type II slot. It lets you insert credit-card sized PC cards for modems, flash memory, network adapters and more.

Get the picture? Now get the Elite 486SX-25 SubNote and get a whole new view of portable computing!

486SX-25 SubNote

Model	Item #	Price
80 Mb	005575	$1439
120 Mb	005576	$1479
200 Mb	005577	$1579
340 Mb	005578	$1759

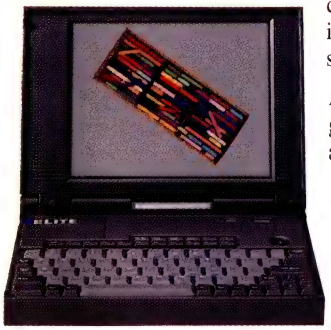
Elements:

Processor:
Intel 486SX SL-Enhanced upgradeable processor
Processing Speed:
25 MHz
RAM:
4 Mb expands, to 12 Mb
Hard Drive:
80 Mb, 120 Mb, 200 Mb or 340 Mb
Screen:
10", 640 x 480 VGA resolution
Backlit display
64 gray shades
Battery Life*:
5 hours
Weight:
3.9 lbs.
512K DRAM plus 64K VRAM for turbo bus accelerated video technology
Simultaneous video
83 keys with 101-key emulation
Built-in trackball
External 1.44 Mb, 3.5" floppy drive
Advanced Power Management
Nickel metal hydride battery
One parallel and one serial port
External VGA and keyboard connectors
One PCMCIA Type II slot
FREE AC adapter and utilities disk
FREE MS-DOS 6.0 installed



Elite 486SLC-33 Color/Monochrome Notebook

486 Notebooks At Starving Artist Prices



Get more power for your money with Elite 486SLC-33 Notebooks. Available in color or monochrome, these notebooks come with fast 33 MHz Cyrix processors, internal cache memory, and up to 8 Mb of RAM.

For maximum system flexibility, you can add an additional RAM module, a V.42bis internal fax modem or an external docking station.

Both models provide non-glare VGA screens that eliminate distortion, flickering and eye strain so you can compute comfortably. Text and graphics appear at 640 x 480 resolutions in 64 gray shades or an eye-catching 256 colors for graphic and spreadsheet applications.

And if you get caught up in your creative endeavors, a quick glance at the LCD panel lets you know which drives are being accessed, when battery power is low, what function keys are enabled, whether external power is being used and if there is a modem ring.

Affordably priced Elite 486SLC-33 Color/Monochrome Notebooks are a real work of art. Order yours today!

486SLC-33 Notebooks

Color

Model	Item #	Price
80 Mb	005461	$1619
120 Mb	005466	$1659
200 Mb	005471	$1759

Monochrome

Model	Item #	Price
80 Mb	005446	$1199
120 Mb	005451	$1239
200 Mb	005456	$1339

Elements:

Processor:
Cyrix 486SLC-33
Processing Speed:
33 MHz
RAM:
2 Mb RAM, expands to 8 Mb
Hard Drive:
80 Mb, 120 Mb or 200 Mb
Floppy Drive:
Built-in 1.44 Mb 3.5"
Screen:
Color - 9", 256 colors
Monochrome - 10", 64 gray shades
Video RAM:
Color - 512K
Monochrome - 256K
Keyboard:
83 key with 101-key emulation
2-button thumball mouse
Weight:
Color - 5.7 lbs. with battery
Monochrome - 5.4 lbs. with battery
Battery Life*:
Color - 4 hours
Monochrome - 6 hours
640 x 480 resolution
Simultaneous video
Advanced Power Management
One parallel and one serial interface
External VGA monitor and keyboard connectors
FREE AC adapter carrying case and MS-DOS 6.0 installed
One year manufacturer's warranty



MidWest Micro

6910 U.S. Route 36 East, Fletcher, Ohio 45326
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Fax:1-800-562-6622
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*Battery life measured with Power Management enabled. Actual battery life may vary.

AD#G1203

MidWest Micro's Gallery of Products

PRINTERS

brother

DOT MATRIX PRINTERS

M-1809	000009	$309
M-1909	000011	$349

INK JET PRINTER

HJ-400	004087	$279

LASER PRINTERS

HL-10h	004363	$1249
HL-10PS	004089	$1499
HL-10V	004060	$959

Canon

BUBBLE JET PRINTERS

BJ-10ex	002056	$249



BJ-200
$259*
002815

BJ-230	002818	$379*
BJC-600	002819	$599
BJC-800	002816	$1495
BJC-820	002817	$1599

LASER PRINTERS

LBP-4SX	002979	$675
LBP-430	003038	$599
LBP-8SX	003037	$999

CITIZEN

DOT MATRIX PRINTERS

GSX-145	001179	$369
GSX-190	002994	$167
200GX Fifteen	002942	$309
GSX-230	002995	$229
GSX-240	003085	$279

PORTABLE PRINTER

PN48 Pro	002943	$209

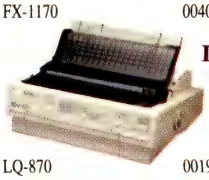
LASER PRINTER

ProLaser 6000	003098	$699

EPSON

DOT MATRIX PRINTERS

AP-2250	003550	$125
AP-3250	003090	$179
DFX-5000	001180	$1399
DFX-8000	001182	$2349
FX-870	002094	$279
FX-1170	004099	$369



LQ-570+
$249
002099

LQ-870	001987	$465
LQ-1070+	002105	$389
LQ-1170	001988	$635
LQ-2550	000074	$939
LX-810	000645	$175

INK JET PRINTERS

Stylus 300	003554	$235
Stylus 800	003552	$329

LASER PRINTERS

AL1000	002125	$619
AL1500	002185	$679
EPL-8000	001194	$875

*Price with manufacturer's rebate. Valid through *12/31/93*.

LEXMARK

DOT MATRIX PRINTERS

IBM Personal Printer 2380	005907	$325
IBM Personal Printer 2381	005908	$449
IBM Personal Printer 2390	005909	$325

LASER PRINTERS

IBM LaserPrinter 10	005902	$1139
IBM Duplex LaserPrinter 10R	005940	$1929
IBM LaserPrinter 12R	005938	$1759

NEC

DOT MATRIX PRINTERS

Pinwriter P3200	002842	$229
Pinwriter P3300	002843	$329
Pinwriter P6200	002840	$409
Pinwriter P6300	002841	$619

THERMAL JET PRINTER

Jetmate 1000	002849	$285

LASER PRINTERS

Silentwriter 95f	002845	$889
Silentwriter 95fx	002847	$1109
Silentwriter 97	003140	$1079
Silentwriter 97fx	003175	$1299

Panasonic Office Automation

DOT MATRIX PRINTERS

KX-P1150	001672	$135
KX-P1624	001052	$349
KX-P1654	001594	$549
KX-P1695	000018	$369
KX-P2023	001658	$199
KX-P2123	001654	$235
KX-P2124	001657	$309
KX-P2180	001653	$159
KX-P2624	001651	$369

LASER PRINTERS

KX-P4410	001656	$559

KX-P4430
$669
001655



KX-P4440	001674	$1249
KX-P4451	001615	$1399
KX-P4455	001596	$1729
KX-P5410	001676	$1029

SAMSUNG

DOT MATRIX PRINTER

SP-2412	004572	$165

LASER PRINTERS

Finale 8000	004550	$1119
Finale 8000i	004571	$1769



SEIKOSHA
A SEIKO GROUP COMPANY

DOT MATRIX PRINTERS

BP-5780	001897	$1175
LT-20XL	001893	$305
SP-2000S	001900	$195
SP-2400AI	003040	$149
SP-2400AP	003041	$219

star THE COMPUTER PRINTER

DOT MATRIX PRINTERS

NX-1001	001597	$139
NX-1040 Rainbow	004080	$165
NX-2420 Rainbow	001600	$289
NX-2430 Multi-Font	002935	$235

THERMAL FUSION PRINTER

SJ-144	004067	$479

LASER PRINTER

LS-5 Laser w/toner	004362	$699

MODEMS

Infotel

PCMCIA FAX MODEMS

9624 PCMCIA	001722	$199
9648 PCMCIA	001624	$179
14.4 PCMCIA	001812	$299

MODEMS

2400 Ext.	004750	$55
2400 Int.	004700	$35
2400 Pocket	001702	$49

FAX MODEMS

9624 Ext.	001556	$79
9624 Int.	004702	$49
9624 Pocket	001688	$75
9624 V.42 Ext.	004755	$99
9624 V.42 Int.	004705	$89
9624 V.42 Pocket	001697	$99



14.4 Int.
$149
004766

14.4 Ext.	004765	$179
14.4 Pocket	001673	$189

U.S. Robotics

MODEMS & FAX MODEMS

Sportster 9600 V.42bis Ext.	003693	$159
Sportster 9600 V.42bis Int.	003692	$155
Sportster 9600 V.42bis Fax Ext.	003691	$175
Sportster 9600 V.42bis Fax Int.	003690	$165
Sportster 14,400 V.42bis Ext.	003689	$179
Sportster 14,400 V.42bis Int.	003688	$159
Sportster 14,400 V.42bis Fax Ext.	003687	$209
Sportster 14,400 V.42bis Fax Int.	003686	$179

HARD DRIVES

SAMSUNG

125 Mb	004573	$169
250 Mb	004559	$215

Seagate

44 Mb	003450	$129
89 Mb	003451	$175
130 Mb	003452	$179
210 Mb	003453	$219
260 Mb	004059	$255
340 Mb	004057	$325

MONITORS

ELITE

ELITE MONITORS

14" .39mm SVGA Color	005702	$209
14" .28mm SVGA Color	005711	$239



14" .28mm N/I SVGA Color
$259
005716

15" .28mm N/I SVGA Color	005721	$349
15" .28mm N/I Digital Color	005730	$359
17" .26mm N/I Multi-Sync Color	005724	$699

CTX

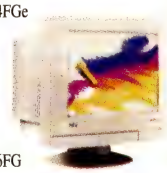
5468NI	004055	$279
5439A	004270	$219
5468A	004085	$255
CMS-1561	004275	$379
CPS-1760DF	004295	$749
CPS-1560	004299	$399

MAG INNOVISION

MX15F	004182	$495
MX17F	004183	$879
LX1564	004184	$385

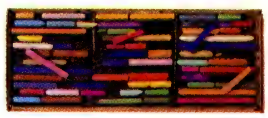
NEC

14" SVGA	002879	$315
3FGe	002876	$609
4FGe	002877	$719



5FG
$1289
002854

6FG	002855	$2335



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$2,149
TEXTMS25CE

Lease as low as $105/Mo.

- 486SX 25MHz CPU
- 640 x 480 VGA 8.2" Color Display
- 256 Colors Simultaneously
- Pre-installed Windows 3.1™ and MS DOS 6.0®
- 4MB RAM, expandable to 20MB
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- MS BallPoint® with QuickPort™ Connection

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- 4MB RAM, expandable to 20MB
- 200MB Hard Disk Drive
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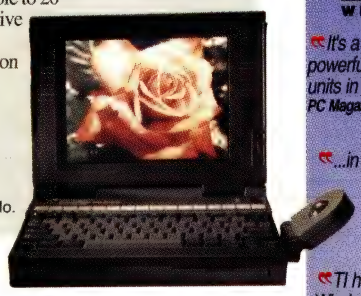
TravelMate 4000 WinDX2™/40 COLOR

PC MAGAZINE EDITORS' CHOICE August 1993

- 486DX2 40MHz CPU
- 640 x 480 VGA 9.4" Color Display
- 256 Colors Simultaneously
- Pre-installed Windows 3.1™ and MS DOS 6.0®
- 8MB RAM, expandable to 20
- 200MB Hard Disk Drive
- MS BallPoint® with QuickPort™ Connection

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"It's a quality desktop replacement...most powerful portable we've seen. One of the lightest units in the entire test group."
PC Magazine, March '93

"...in our battery tests, the TI 4000 WinDX2/50 achieved a magnificent 6 hours and 24 minutes."
Portable Computing, April/May '93

"TI has done more to customize and optimize Windows than the other notebook vendors."
Windows Magazine, February '93

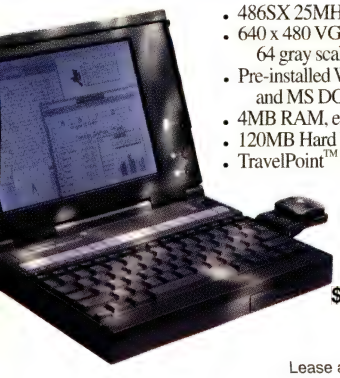
TravelMate 4000E WinDX2™/50

- 486DX2 50MHz CPU
- 640 x 480 VGA 10" Display, 64 gray scales
- Pre-installed Windows 3.1™ and MS DOS 6.0®
- 4MB RAM, expandable to 20MB
- 200MB Hard Disk Drive
- MS BallPoint® with QuickPort™ Connection

$2,649
TEXTMD25ØE
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TravelMate 4000E WinSX™/25



- 486SX 25MHz Processor
- 640 x 480 VGA 10" Display, 64 gray scales
- Pre-installed Windows 3.1™ and MS DOS 6.0®
- 4MB RAM, expandable to 20MB
- 120MB Hard Disk Drive
- TravelPoint™ pointing device

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Insight®

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TravelMate 4000 WinDX™/25

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- 486DX 25MHz CPU
- 640 x 480 VGA 10" Display, 64 gray scales
- Pre-installed Windows 3.1™ and MS DOS 6.0®
- 4MB RAM, expandable to 20MB
- 120MB or 200MB Hard Disk Drive
- TravelPoint™ pointing device

$1,999 120MB
TEXTMD251

$2,129 200MB
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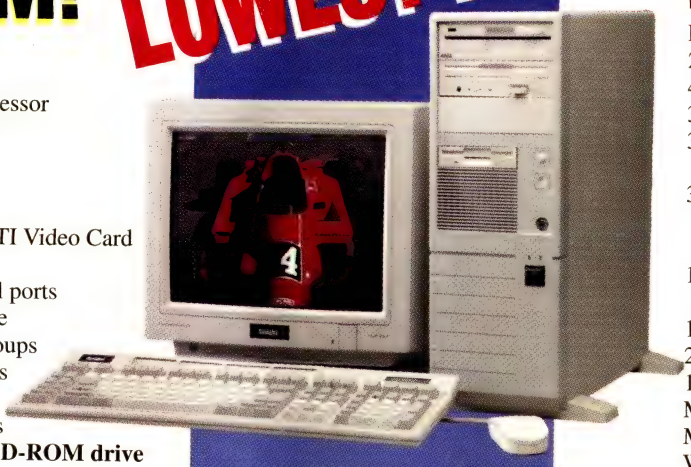
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New PCI interface motherboard
2 PCI, 4 ISA, 1 PCI/ISA Slots
16MB RAM, 256K Cache
540MB 12ms HDD w/cache
15" NI SVGA Monitor & PCI ATI Video Card
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NEW 273-pin socket for future Pentium™ processor upgrades
PLUS: 320ms, double-speed CD-ROM drive Toolworks MM Encyc., Adventures, Fractals and National Parks Guide MPC CD's

Insight's PCI P60 CD
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Insight 486 VL

Fully Upgradable Intel 80486 CPU
2 VESA VL-Bus™ Compatible Slots
4MB RAM - 128K Cache
340MB 12ms IDE Hard Drive
32 Bit VL-Bus™ Compatible IDE Controller
32 Bit VL-Bus™ Compatible 1MB Graphics Accelerator Super VGA Card
15" Non-Interlaced Super VGA Color Monitor
1.2MB & 1.44 FDD
2 Ser. & 1 Par. Port
101 Key Kbd.
Mouse
MS-DOS
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Desktop Case incl., Full- or Mid-Tower Available

486DX-33MHz Insight 486 VL
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Lease as low as $90/mo.
486SX-33MHz $1,599
486DX2-66MHz $1,899

Insight 486SX VL CD

Fully Upgradable Intel 80486 CPU
2 VESA VL-Bus™ Compatible Slots
4MB RAM - 128K Cache
340MB 12ms IDE Hard Drive
32 Bit VL-Bus™ Compatible IDE Controller
32 Bit VL-Bus™ Compatible 1MB Graphics Accelerator Super VGA Card
14" Non-Interlaced Super VGA Color Monitor
CD-ROM Drive with 320ms, 340KB/sec.
1.2MB 5.25" Floppy Drive
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2 Serial Ports, 1 Parallel Port
Enhanced 101 Key Keyboard
Mouse, MS-DOS - Windows 3.1
Desktop Case, Full Tower or Mid-Tower Available

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486sx-33MHz VL CD
$1,799
Lease as low as $92/mo.

High-quality, high-value Hitachi SuperScan™ monitors for all of your applications.



NEW! SuperScan™ 15s 15"
Digital microprocessor control, Energy Star, MPR II, flat, square screen. 1280 x 1024 NI .28 dot pitch.
CM1586MU $499

NEW! SuperScan™ Elite 17"
Digital microprocessor control with 31 presets. True color control plus white balance selection. Energy Star. MPR II, Keyboard computer control, 1600 x 1200 NI, .26 dot pitch.
CM2Ø95MU $1,349

SuperScan™ Pro 20"
1280 x 1024, NI, .31 dot pitch. For publishing, CAD/CAM, Multimedia and Windowing.
CM2Ø87 ..... $1,699

SuperScan™ 20s 20"
Low cost! 1280 x 1024 NI, .31 dot pitch.
CM2Ø95MU $1,499

NEW! SuperScan™ Elite 21"
Digital microprocessor control with 31 presets. True color control plus white balance selection. Energy Star. MPR II, Keyboard computer control, 1600 x 1200 NI @ 66Hz, .28 dot pitch flat, square screen.
CM2188 ..... $2,599

Ergonomic Mouse

Digitus, the Magic Click Mouse eliminates cramped, tired hands and helps you work more efficiently. Available in black or white..... **$45**



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Zoom's V.Fast Class faxmodems provide amazing 24,000 bps uncompressed data transmission, or up to 96,000 bps with V.42bis data compression. You also get 14,400 bps send/receive fax, and full V.32bis compatibility for connection to slower modems. Bundled software incl. Winfax Lite, DOSfax, and COMit data communications for DOS and Windows.



VFP24K Internal 175
VF24K External 199
VFPV32BIS Internal..... 129
VFP14.4V Internal..... 165
VFX14.4V External..... 199
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Hard drive installation, preventive maintenance and diagnostics. Helps prevent future disasters and ensure data integrity. Includes 60-second IDE Quick Install and Boot Sector Virus protection.

Drive Pro SWRDDMHØ1..... $69

EZ Drive
Fast and easy IDE setup! Hassle-free 60-second installation and upgrade kit. Any size IDE drive made bootable and software ready in less than a minute! Sets the system CMOS. Partitions. DOS formats. Transfers the operating system. User selectable automatic virus protection insures that the critical boot sector is virus-free upon every boot up. Installs maximum drive capacity automatically with our user-definable drive type. Install IDE's into systems with MFM/RLL's. Advanced IDE surface scanning and defect management. Set it up right, the first time!

EZ Drive SWRDDMHØ2 ..... $35

HARD DRIVES *International*



Reveal MultimediaFX - Ø4

Internal CD-ROM drive; 320ms access time, double speed, 00KB transfer rate. Multi-session Photo CD ready.
SC400 True 16-bit stereo sound card,
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Kings Quest VI CD
Stellar 7 CD
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1993 Guinness Disc of Records CD
National Parks Guide MPC CD
Clip Media II SE on CD
Macromedia Action SE on CD
Microsoft Works Multimedia Edition CD
Adventures CD

FREE software!

MMRVMFXØ4..... $499

HARD DRIVES 40MB to 2.9 GIG!

Complete installation kit, including:
5 1/4" mounting frame, Data Cable Rail Set, Screws Jumper Blocks & Bezels
HDI's Hard Drive Installation Guide with step-by-step installation instructions

Size	Access	Form Factor	Manufacturer	Interface	Model#	Bare Kit	16 Bit Kit
42MB	28ms	3.5" 1"H	Seagate	IDE	ST351A	$139	159
130MB	15ms	3.5" 1"H	Seagate	IDE	ST3144A	169	189
250MB	12ms	3.5" 1"H	Western Digital	IDE	WD225ØA	219	239
250MB	12ms	3.5" 1"H	Conner	IDE	CP3Ø254	229	249
340MB	12ms	3.5" 1"H	Western Digital	IDE	WD234ØA	279	299
345MB	15ms	3.5" 1"H	Maxtor	IDE/SCSI	MX7345A/S	299/349	349/489
452MB	12ms	3.5" 1"H	Seagate	IDE/SCSI	ST355ØA/N	409/539	429/689
510MB	12ms	3.5" HH	Fujitsu	IDE/SCSI	FJ2624A/S	599	619/749
540MB	12ms	3.5" 1"H	Seagate	IDE/SCSI	ST3655A/N	579/599	599/749
1050MB	15ms	3.5" FH	Seagate	SCSI	ST112ØØN	899	1,049
1050MB	10ms	3.5" HH	Micropolis	IDE/SCSI	MC221ØA/S	889	909/1,039
1748MB	14ms	5.25" FH	Micropolis	SCSI	MC1548	1,099	1,249
1900MB	13ms	5.25" FH	Seagate	SCSI	ST421ØØN	1,479	1,629
2100MB	11ms	5.25" FH	Micropolis	SCSI	MC1926	1,949	2,099
2900MB	12ms	5.25" FH	Seagate	SCSI	ST434ØØN	2,199	2,349

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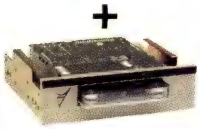
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When Midwest Computer Works made PC Direct their driving force, sales took off at top speed.



Midwest Computer, co-founders. Steve Melnick and Susan Freed

When Midwest Computer Works opened for business in 1989, co-founders Steve Melnick and Susan Freed had a vision of one day becoming a successful global enterprise. They made this happen by embracing a customer-oriented philosophy and by specializing in networking and laptops. Whether it's shipping orders the same day they're ordered, offering easy access to technical support from certified Netware engineers, or upgrading the telephone systems so every call is answered by a real-live person, Midwest Computer Works works.

In fact, it's working so well that they're preparing for a massive growth period. Steve Melnick says, "We've redesigned our infrastructure to handle it so that we're ready to now increase our staff and almost double the size of the company." Obviously, Midwest Computer Works' approach and its 100% commitment to its customers paid off. And of course, it didn't hurt that they selected a winning media strategy.

Even though they started small, they didn't let size stand in the way of their big dreams. "We started from nothing and went right into PC Magazine," says Melnick. "And we found instant success from that. Which is part of the reason why we're so successful today, because we didn't start with some of the smaller magazines trying to work our way up."

"We decided that we wanted to be a major player in the mail order business in the United States. And in order to do that, when we did our research, it showed that PC Magazine was the place to be. The response has been great. We've noticed an increase in our business based on the amount of subscribers that have been added."

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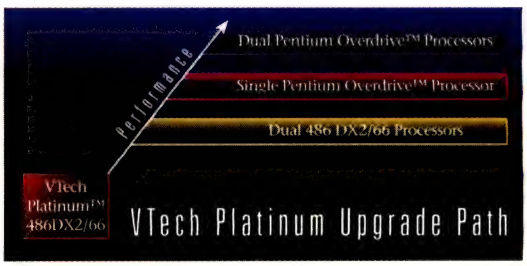
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- 3.5" Disk Drive
- 424 MB Hard Drive
- Double Speed CD Rom
- 15" Non-Interlaced Monitor
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- SCSI II (Imbedded in BIOS)
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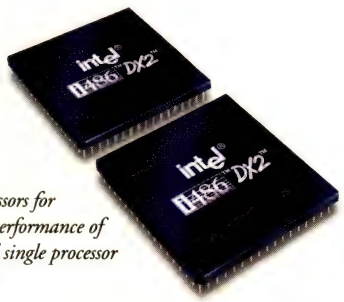
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Optional Drives
14.4k Modem
Additional RAM

COMPUTER SHOPPER Benchmarks

VTech Platinum SMP Dual

	VTech Platinum SMP Dual	Benchmark System: Dell 450/M	
2D Labs PC Bench 7.01			
DOSMark (higher is better)	92.7	62.3	
System Performance			
16-bit Protected Mode Mix	552.3	413.3	passes/sec
16-bit Real Mode Mix	597.0	450.0	passes/sec
Floating Point Emulation	1,102.2	830.4	ops/sec
Main Coprocessor	19.6	14.8	K-ops/sec
Memory Performance			
Ext. Memory 16-bit Read/Write	12,767.0	9,638.0	K/sec
Ext. Memory 32-bit Read/Write	22,130.0	16,668.0	K/sec
Conv. Memory 16-bit Read/Write	13,122.5	9,550.0	K/sec
Video Performance			
Direct Screen Write (16-bit)	7,517.6	6,559.0	K-chars/sec
Screen to Screen Bitbit (16-bit) pixels/sec	12,380.2	10,460.2	K-
Screen to Screen Bitbit (32-bit) pixels/sec	15,313.9	12,664.3	K-
Disk Performance (512-byte records)			
32Mb Sequential Read/Write	909.6	663.2	K/sec
32Mb Random Read/Write	27.2	16.7	K/sec
2Mb Sequential Read/Write	1656.3	606.1	K/sec
2Mb Random Read/Write	902.3	296.0	K/sec
256Mb Sequential Read/Write	3,022.4	2,371.1	K/sec
256Mb Random Read/Write	1,669.1	1,147.9	K/sec
System Configuration			
CPU Manufacturer	Intel	Intel	
CPU Type	486DX2/66	486DX2/50	
Internal (CPU) RAM Cache	8	8	K
External RAM Cache	256	128	K
Disk Hardware Caching	256	64	K
Video Min./Max. NI Scan Rate	43/74	56/72	Hz
Monitor Min./Max. NI Scan Rate	32/72	50/90	Hz
SmartDrive Enabled	2,048	2,048	K

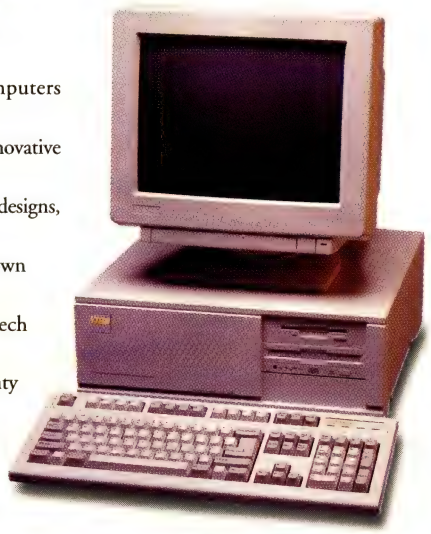
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FREE ON SITE SERVICE	YES	YES	YES		YES	YES
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EXPRESS PARTS SERVICE	YES	YES	YES	YES		
FAX TECHNICAL ADVICE	YES	YES	YES	YES		
SYSTEM FEATURE						
ANTI VIRUS SOFTWARE	YES					
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SERVICE VALUE RATING PC COMPUTING AUG. 1993	★★★★★	★★★★	★★★★	★★★★	★★★★	★★★★

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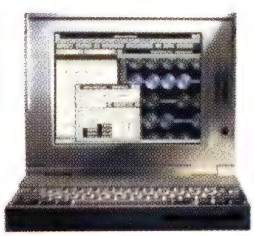
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$1999*



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Active Mono	209MB	$3099

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- Local bus video**
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486DX2/50	4MB	Active	$3899

**except DX2/40

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T1950 486DX2/40	Monochrome	120MB	$1899
T1950 486DX2/40	Monochrome	200MB	$2099
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Screen	Hard drive	Price
Monochrome	120MB	$2399*
Monochrome	200MB	$2649
Active Matrix Color	120MB	$3889
Active Matrix Color	200MB	$4099
Active Matrix Color	340MB	$4449

***Lease for 88.04/mo.**



T6600

Fully Equipped Multimedia Computer

- ▲ 486DX2/66 processor
- ▲ 8MB RAM, expandable to 40MB
- ▲ 10.4" active matrix color display
- ▲ 16mm PCMCIA slot
- ▲ 2 full length 16-bit ISA slots
- ▲ Detachable 101 key keyboard
- ▲ 2 built-in stereo speakers
- ▲ Microsoft Sound System
- ▲ MS-DOS 6.0, Windows 3.1, Asymetrix COMPEL and MediaBlitz!

Model	Description	Price
T6600C	Base model	$6289*
T6600C/CD	Base model + Toshiba 5.25" 200MS CD-ROM drive	$6799
T6600C/CDV	Base model + CD-ROM drive+ Mambo DVI board	$7859

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- Windows Accelerator
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Processor	Hard Drive	Price
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486SX/33	170MB	$1029
486DX/33	170MB	$1169
486DX/33	260MB	$1229
486DX2/50	260MB	$1399
486DX2/66	260MB	$1529

Color VGA monitors start at $229.99

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NEC

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Processor	Hard drive	Price
486SX25*	170MB	$999*
486SX33	210MB	$1249
486DX2/66	250MB	$1739

*486SX25 does not include modem

NEC SVGA color monitor $319.99

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$999*



COMPAQ

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- 3.5" floppy drive
- Local Bus graphics
- MS-DOS 6.0, Windows 3.1, Mouse

Model	Hard drive	Price
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486SX25	240MB	$1089
486DX33	120MB	$1389
486DX33	240MB	$1469
486DX2/66	340MB	$2299

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- 120MB or 210MB hard drive
- Local bus video 1024x768
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4/33	120MB	—	$1299
4/33	—	210MB	$1539
4/66d	—	210MB	$2099

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Bravo LP

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4/33	4MB	170MB	$1449
4/33	8MB	340MB	$1899
4/66d	8MB	340MB	$2449

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- MediaVision JAZZ 16 sound card
- Labtec speakers
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- CD-ROM titles include: PFS: Window Works, Compton's Enclyclopedia, Dinosaur Adventure & Space adventure

Processor	Hard drive	Price
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486SX33	250MB	$1899

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4/33 343W	8MB	340MB	$1999
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4/66d 343W	8MB	340MB	$2539

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COMPAQ

Contura

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- 4MB RAM
- Trackball, MS-DOS, Windows
- 3-year warranty

Display	Hard drive	Price
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Dual scan color	120MB	$2699
Dual scan color	209MB	$2879

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Great New Product

COMPAQ

Concerto

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- 2 PCMCIA slots
- Integrated, detachable keyboard
- Untethered, intelligent pen
- MS-DOS 6.0, Microsoft Windows for Pen Computing, Inkware Notetaker, Pen Power for Excel by SLATE

Processor	Hard drive	Price
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486SL25	250MB	$2649
486SL33	250MB	$2929

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$2359*



AST Authorized Systems Reseller

PowerExec

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- Windows 3.1
- Trackball

Processor	Model	Price
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486SL25 Active Color	203W	$4029
486SL33 Active Color	203W	$4229
486SL33 Active Color	343W	$4629

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Monochrome	$2749*
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$2749*



NEC

UltraLite Versa

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- 2 PCMCIA slots
- Local bus graphics
- MS-DOS 6.0, Windows 3.1, trackball

Processor	Screen	Hard drive	Price
486SL25	Active color	120MB	$3799
486SL25	Active color	180MB	$4049
486SL33	Monochrome	180MB	$3229*
486SL33	Monochrome	250MB	$3439
486SL33	Active color	180MB	$4299
486SL33	Active color	250MB	$4499

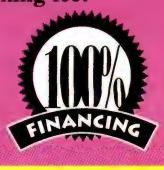
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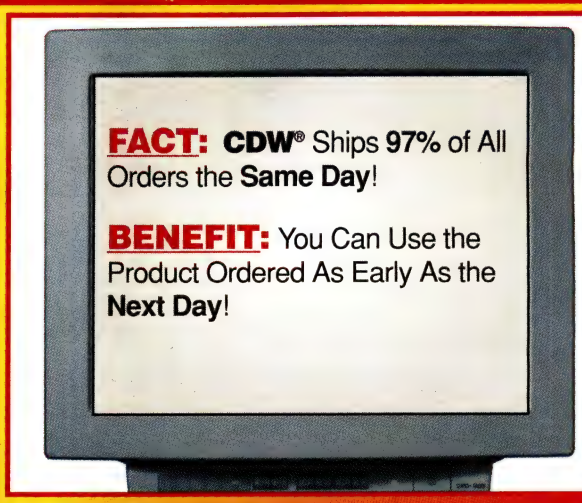
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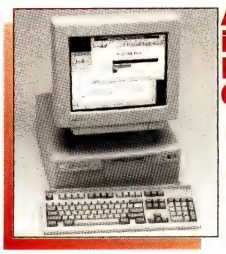


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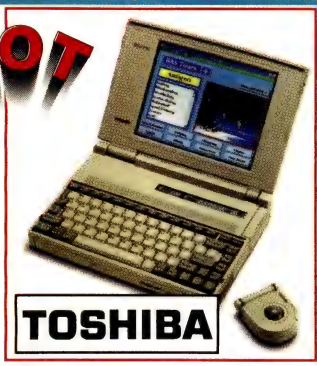
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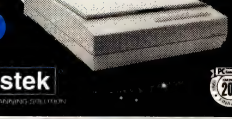
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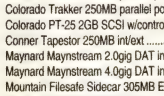
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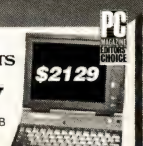
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PostScript	YES	(Optional)
Resolution	600DPI	600DPI
Upgradable Language	YES	NO
Available Duplex Option	YES	NO
MCW Price	**$1349**	$1368

And the Winner is The 4039-10R from IBM!

IBM vs. HP



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Printspeed	5ppm	4ppm
Paper Input	150 Sht.	100 Sht.
Optnl. 2nd Drwr.	YES	NO
Fonts	40	26
MCW Price	**$659**	$674

And the Winner is The 4037-5E from IBM!

IBM vs. HP



	Execjet II 4076	Deskjet 500
Paper Capacity	150 Sht.	100 Sht
Resolution	600x300	300x300
Cart. Life	1000 pgs.	500 pgs.
Print Speed	300 cps	240 cps
Res. Enhncmnt.	YES	NO
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And the Winner is The Execjet from IBM!

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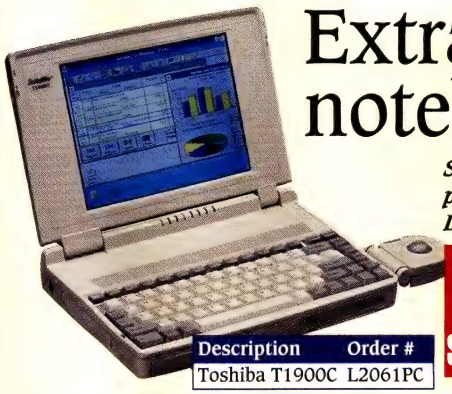
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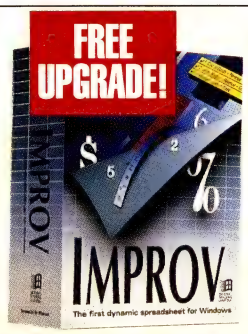
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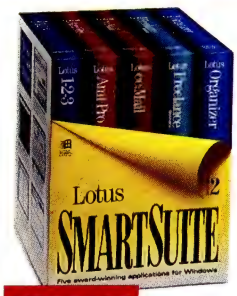






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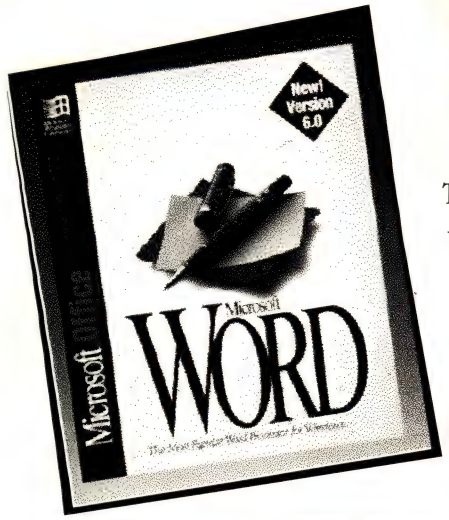
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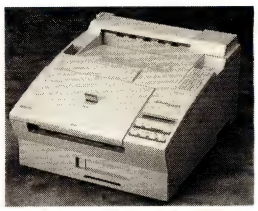
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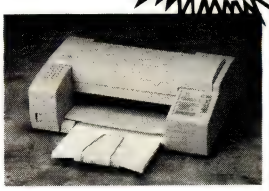


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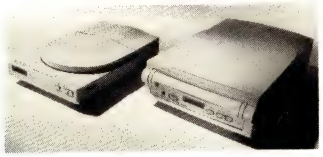
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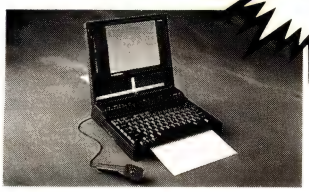
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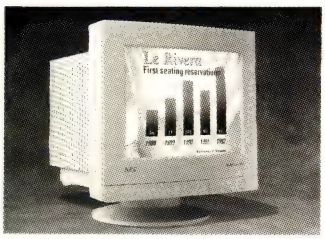
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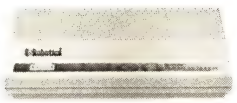
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2MB C822051	S124	4MB C822021	S235

HP LaserJet 4L

1MB C2024A	S47		

HP LaserJet IIP, III, IIIP, IIID

2MB 33475B	S96	4MB 33477B	S174

HP LaserJet II, IID

2MB 33444B	S110	4MB 33445B	S195

HP LaserJet IIIsi, 4, 4M, 4Si, 4SiMX, XL300, DeskJet 1200c

1MB C2063A	S50	2MB C2064A	S75
4MB C2065A	S195	8MB C2066A	S410

HP DeskJet 500, 500C

256K 27070B	S41		

HP DesignJet 600 Inkjet Plotter

4MB C2065A	S195	8MB C2066A	S410

IBM/Lexmark Laser 4029 All Models

2MB 1183334	S47	4MB 1183335	S132

IBM/Lexmark Laser 4019, 4019e

2MB 1039137	S116	3.5MB 1038675	S174

IBM/Lexmark Laser 4039, 4079 All Models

4MB 1328363	S167	8MB 1328365	S326

Kyocera FS-1500A Ecosys

2MB N/A	S141	4MB N/A	S182

Kyocera FS-3500A Ecosys aSi

1MB N/A	S167	4MB N/A	S167

NEC SilentWriter 95 & 97 series

2MB N/A	S100		

OkiLaser 400

1MB 70014701	S67	2MB N/A	S106

OkiLaser 800, 820

2MB N/A	S157	4MB N/A	S190

OkiLaser 810

1MB 70021001	S93	2MB 70021101	S132

OkiLaser 830, 840

2MB 70016501	S126		

Panasonic LaserPartner 4410, 4430

2MB KX-P444	S113	4MB N/A	S191

Panasonic LaserPartner 4450i, 4420

2MB KX-P441	S129	4MB N/A	S189

Panasonic LaserPartner 4455

2MB KX-P442	S108		

Texas Instruments MicroLaser, XL

1MB 2555739-0001	S46		

Toshiba Page Laser 6

2MB LS6-N80090	S120	4MB LS6-N80100	S198

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PacificPage PE	S279
PacificPage PE/Xi includes 4 MB IIP, III, IIID, IIIP	S769
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Bravo 3/25s

2MB	500710-004	S96	8MB	500824-002	S242

Advantage! Plus 486DX/33; DX2-50; DX2-66

4MB	500510-008	S148	8MB	500824-001	S242

Advantage! 386SX/20; 25, Advantage! Pro SX/25, Bravo 3/33s

2MB	500962-001	S97	8MB	500962-002	S215

Advantage! Pro 486DX/33; SX/25, Bravo LC 4/25s; 33; 33s; 50d; 4/66d

2MB	500987-001	S86	4MB	500987-002	S167
16MB	500987-004	S447	32MB	500987-005	S895

Premium 386/25; 33; 33T, Premium II 386SX/16; 20; 25

1MB w/WPB	500780-003; 002		S33

Advantage! 486/25; 33; 33p; SX20, Bravo 4/33; 486/25; Premium 4/25; 33TE, Server SE 4/33

2MB w/WPB	500718-004; 780-005		S96

Premium 386/33T, 386SX/16, Premium II 386SX/20; 25

4MB w/WPB	500780-004		S177

Advantage! 486/25; 33; 33p; SX20, Power Premium 3/33, 4/33; 33s; 50d; 66d, Premium 386/33TE, 486/25; 25TE; 33; 33E; 33TE, Premium II 386/25; 33, 486/33, 486SX/20

Premium Server SE 4/33

8MB w/WPB	500780-001		S354

IBM

AMBRA Enterprise 386, Hurdla 386, Sprinta 386 (all models)

2MB	N/A	S94	8MB	N/A	S329

AMBRA Enterprise 486, Hurdla 486, Sprinta 486 (all models)

4MB	N/A	S195	16MB	N/A	S659

PS/1 286, 386SX

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PS/1 Consultant, Essential, Expert models x43, x44, PS/Valuepoint all models except Cxx series

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PS/1 Consultant, Essential, Expert models x76

16MB Kit	96F9291		S669

PS/2 25/286, 30/286, memory adapter 1497259

2MB Kit	30F5360		S91

PS/2 35SX; LS, 40SX, 50Z, 55SX; LS, 65SX; LS, 70, XStation

1MB	6450603	S50	2MB	6450604	S97

PS/2 70-A21; A61; B21; B61, PS/1 Consultant, Essential, Expert models x11, x13, x14, PS/Valuepoint Cxx series

2MB	6450608		S100

PS/2 35SX; LS, 40SX, 55SX; LS, 65SX; LS, XStation, PS/Valuepoint Cxx series, adapter board 34F3011 or 34F3077

4MB	34F2933 or 87F9977				S195

PS/2 35SX; LS, 40SX, PS/Valuepoint Cxx series

8MB	6450129				S410

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2MB	6450902		S97

PS/2 90 XP, 95 XP, P75 (pairs), 56, 57 (all), PS/1 Consultant, Essential, Expert models x11, x13, x14, PS/1 Pro M2123, RS/6000 POWERstation/POWERserver 220 series

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4MB	141684-001	S195	8MB	141685-001	S410

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4MB Module	113132-001	S200
4MB Board	113645-001	S252

DeskPro 386s/16

4MB Module	112534-001	S210
4MB Board	113634-001	S282

DeskPro 3/25i; 33i, 4/25iS; 33i; 66i, 286N; 386N; 386SX/20; 20N, SystemPro LT Series, ProSignia PC Server 486/33; DX2/66

Portable 486c, M Series expansion boards

1MB	118688-001	S50	2MB	118689-001	S97
4MB	118690-001	S195	8MB	112877-001	S410

ProSignia PC Server 486/33; DX2/66

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SystemPro XL (486-50)

16MB	136816-001	S752	32MB	136817-001	S1497
64MB	N/A	S2002	128MB	139918-001	S8809

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2MB	115144-001	S92	8MB	116561-001	S369

DeskPro 386M, 486M, SystemPro LT, System Pro E series

2-64MB Board w/2M	129160-001	S279

DeskPro 386/33L, 486/33L, SystemPro

6 Socket Brd w/2MB	116569 + 115144-001	S317

Dell

Power Desktop 325D, 325P, 333D, 333P, 433P, 486P, 486D

1MB	310-2505	S50	4MB	310-2507	S195

Power Desktop 486P, 486D

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PowerLine Workstation 420; 425; 433; 450; 450DE/2, 466DE

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4-16MB w/4MB	34F3011	S317

NEC

Image 425, 433, 466

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Ready 425, 433

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2MB	N/A	S235
4MB	N/A	S318

PowerMate SX/20

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2MB	APC-H655	S229
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PowerMate 386/33E, 486/25E

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16MB	ME-90	S649			

Z-Server 425SE, 433DE, 450DE

4MB	ME-432	S194			
8MB	ME-102	S376			
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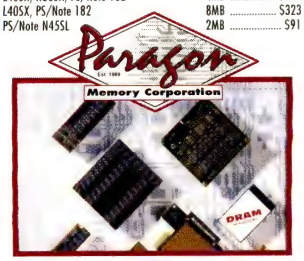
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PowerExec 3/25SL, 3/25SL-C, EL	4MB	S184	
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PS/2 CL57SX and ThinkPad 700,	4MB	S212	
700c, 720, 720c	8MB	S402	
ThinkPad 710T	4MB	S188	
	8MB	S399	
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UltraLite & Cellular Workstation SX/20	2MB	S147	
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UltraLite III, SL/25C	8MB	S359	
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Texas Instruments

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	4MB	S187	
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T1200XE, 1600, 3100E	2MB	S80	
T3100SX, 3200SX, SXC	2MB	S80	
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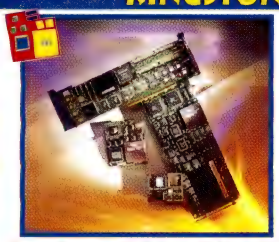
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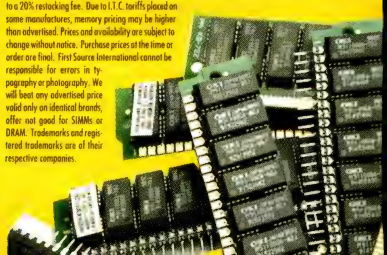
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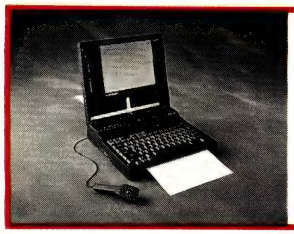


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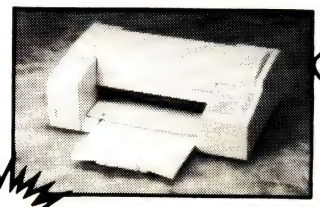


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CIRCLE 015 ON READER SERVICE CARD

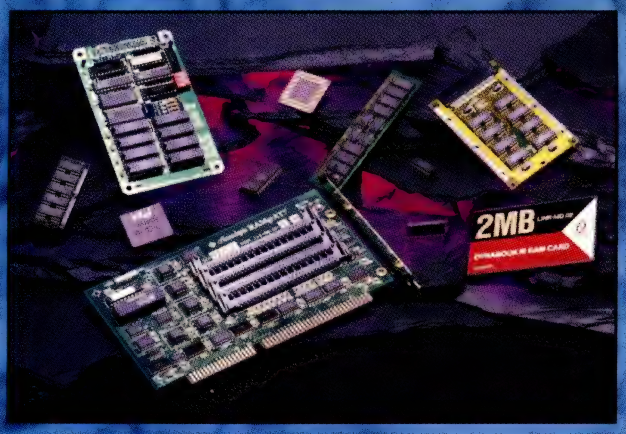
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CIRCLE 391 ON READER SERVICE CARD

How PC Direct Helped Computer Discount Warehouse Found "Customer University"

All the employees at the Computer Discount Warehouse are still in school. No, they're not teenagers anymore, but they're all enrolled in a program called CDW University—which they also call "Customer U."

"We believe that the only way to grow is to make the customer #1," says Michael Krasny, the company's CEO. "That's why we established an on-going, mandatory training program that focuses on customer service and product briefings. Our employees also have personal, hands-on experience of a lot of the products they sell—and they know how to treat the customer right."

The customer support program at CDW, a ten-year-old reseller of PC hardware and software, includes free technical support from 8 a.m. to 7:30 p.m. "We guarantee that support calls will be answered within three minutes," says Krasny. He also points out that a $10 million product inventory makes it possible for the company to provide same-day order shipment.

Computer Discount Warehouse has turned their success into an opportunity to offer better customer service, and Krasny singles out his advertising in PC Magazine as the cornerstone of his success. "We've been in the PC Direct section since 1986, and we've never missed an issue. Our most loyal customers, the ones who appreciate service, come to us through PC Magazine. No matter how you look at it—closing rate, calls per ad dollar—PC Magazine is tops."

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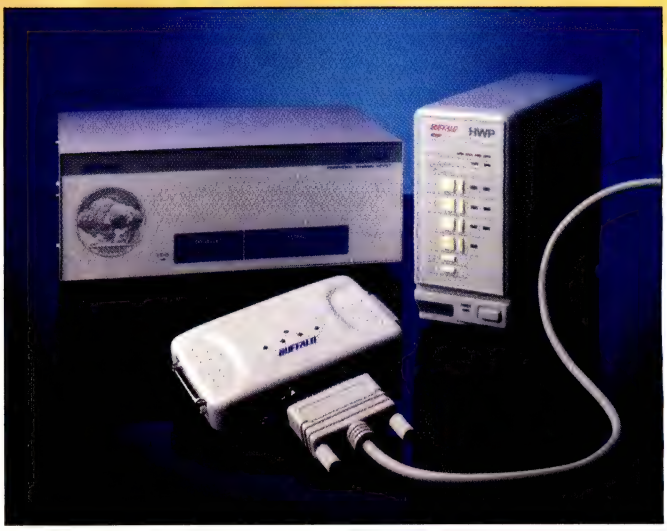
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Epson 8000	–	–	89	–	Call	–	–	Call	–	–	–
Epson 1000, 1500	–	–	–	Call	–	–	Call	–	Call	–	–
HP 2, 2D–	–	–	–	119	–	–	199	–	–	–	–
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HP 3SI	–	–	69	–	–	–	199	–	–	399	–
HP 4SI	–	–	–	69	–	–	199	–	–	399	–
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HP Deskjet 1200C, 1200C/P–	–	–	–	89	–	–	199	–	–	399	–
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NEC 95	–	–	–	99	–	–	–	–	–	–	–
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Oki 400 E	–	–	135	189	–	–	–	–	–	–	–
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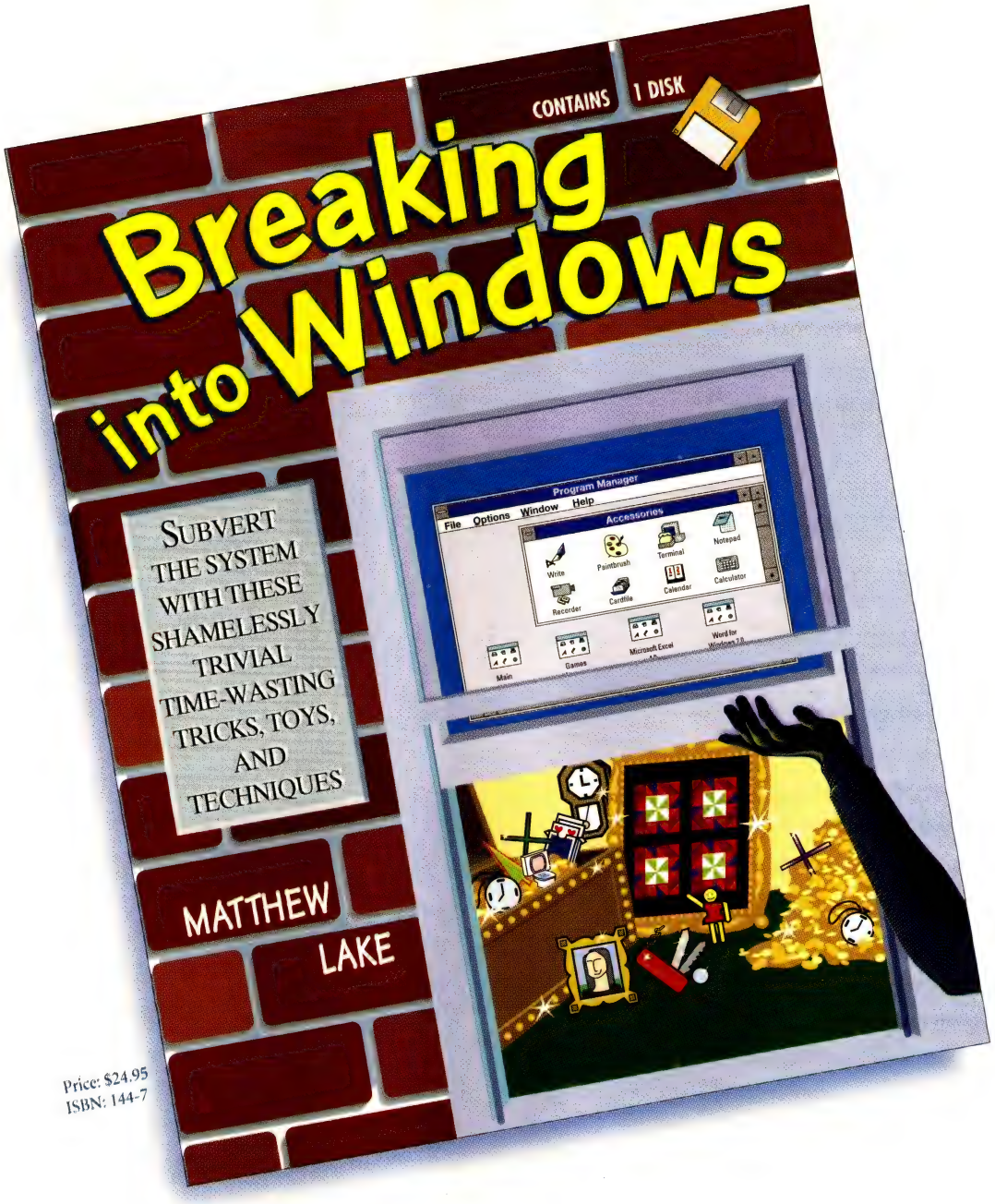
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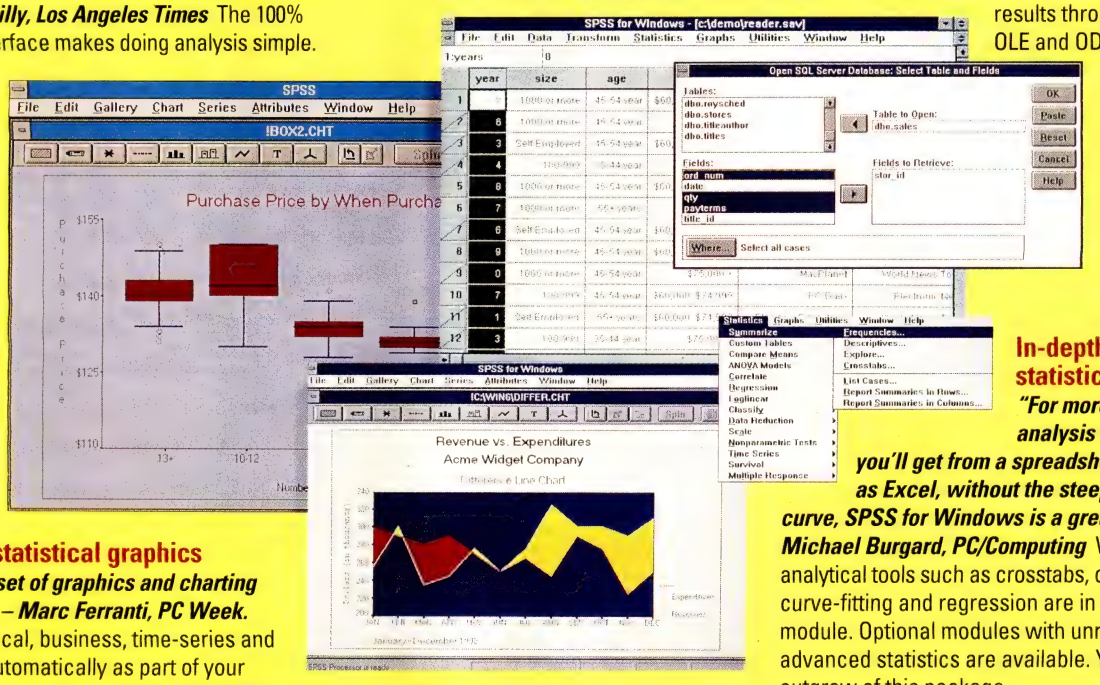
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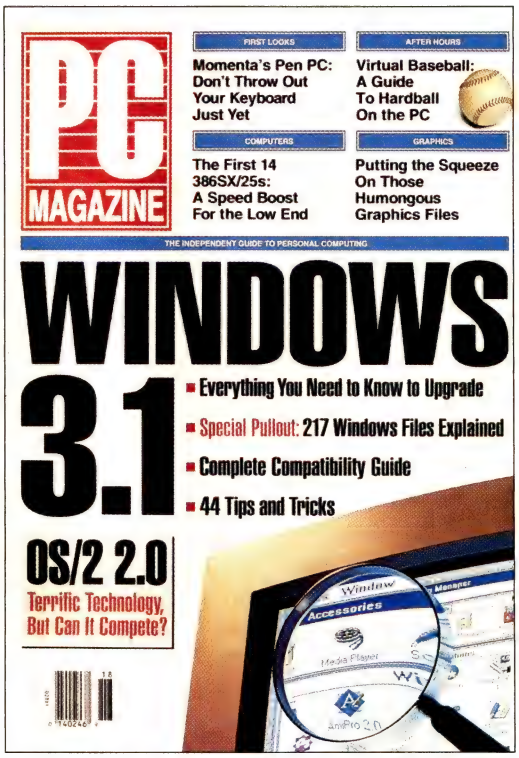
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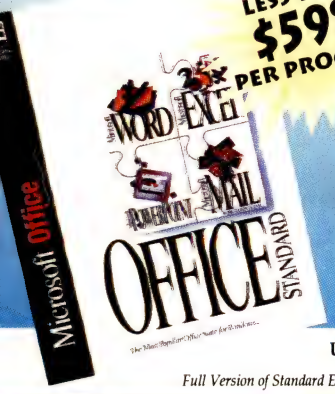
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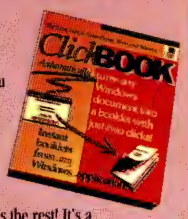
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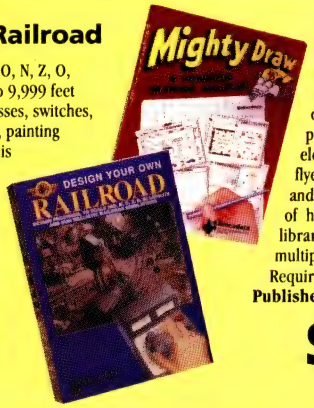
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407-419

Windows
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417

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420-430

BusinessCard
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431-436

	Premier	Classified
HARDWARE		
Boards/Components/Chips	408	420
Communications	408	
Computer Systems	409	420
Input/Output Devices/Barcoding	410	422
Mass Storage Devices	411	424
Midi		
Multi-Media	411	
Networking	412	
OS2		
Security		
Video	413	
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Artificial Intelligence		
Business Applications	413	425
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Education	414	426
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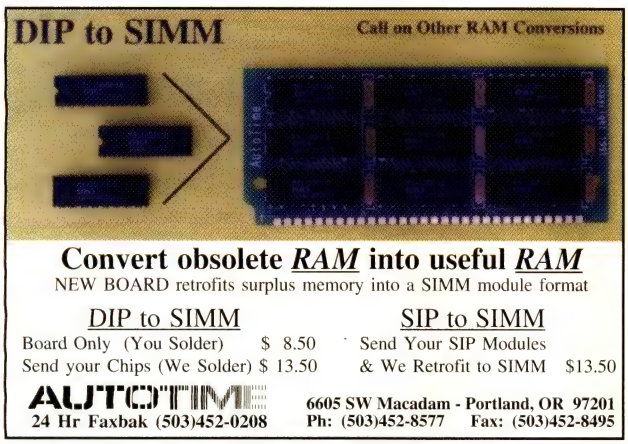
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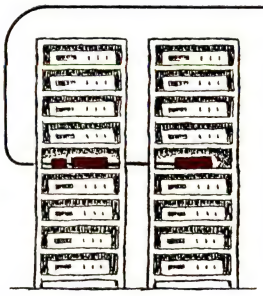


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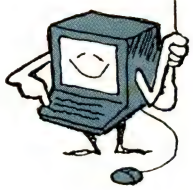
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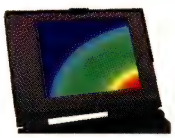
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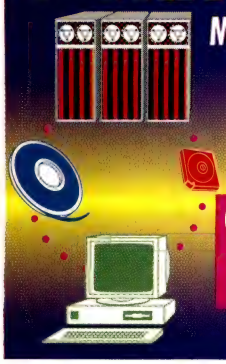
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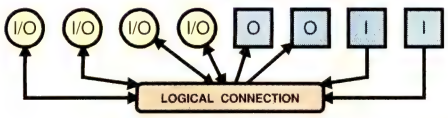
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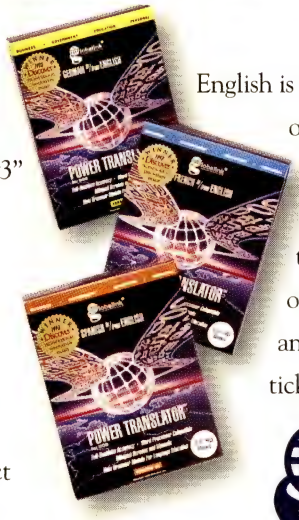
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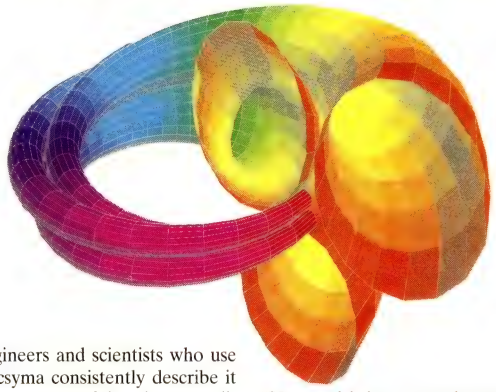
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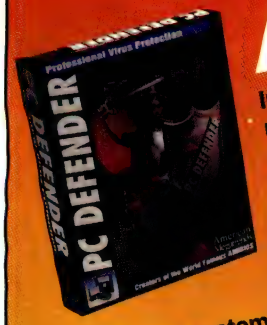
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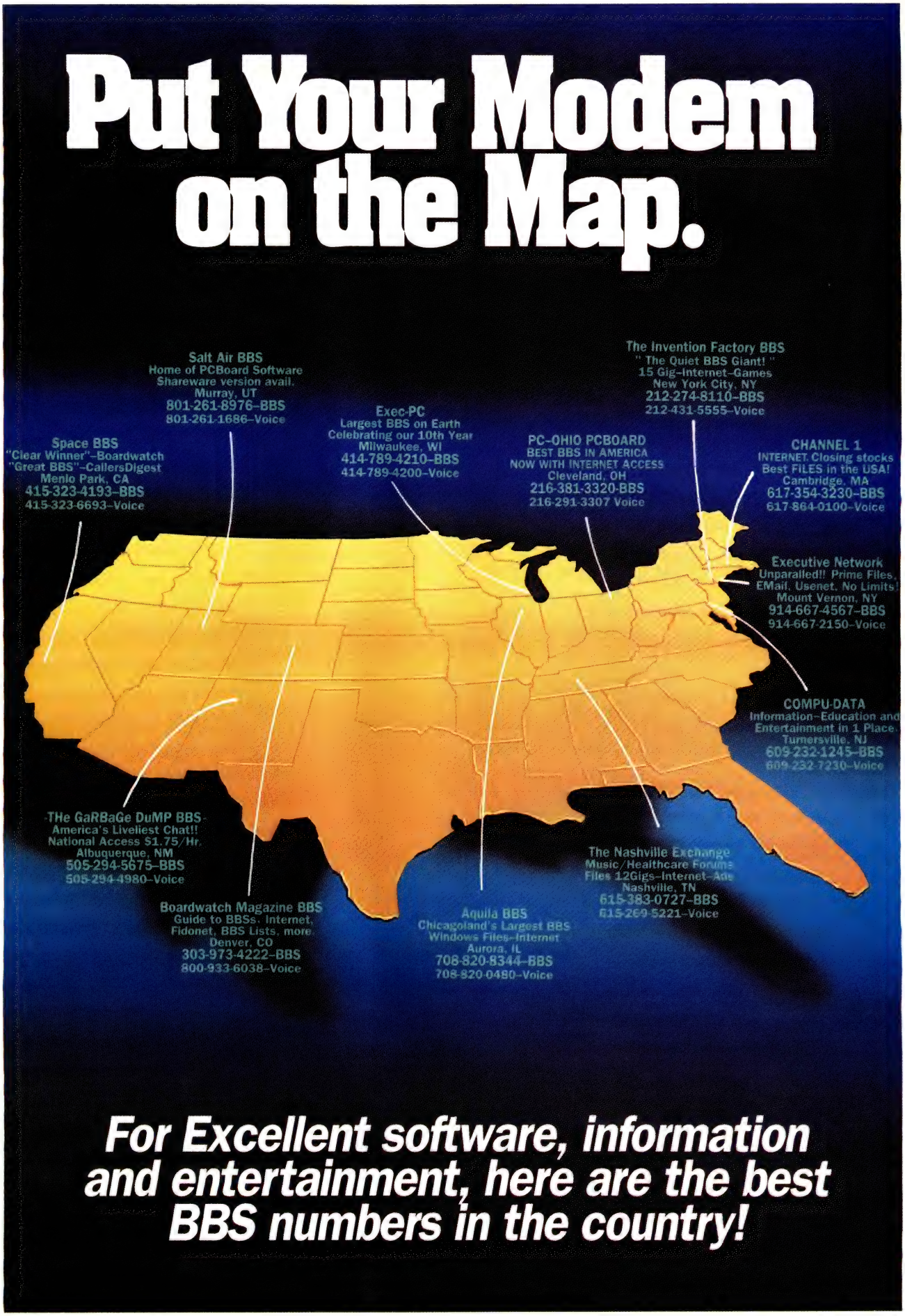
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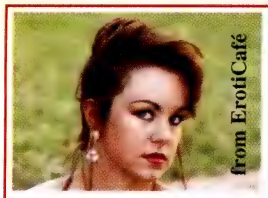
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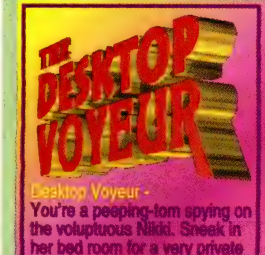
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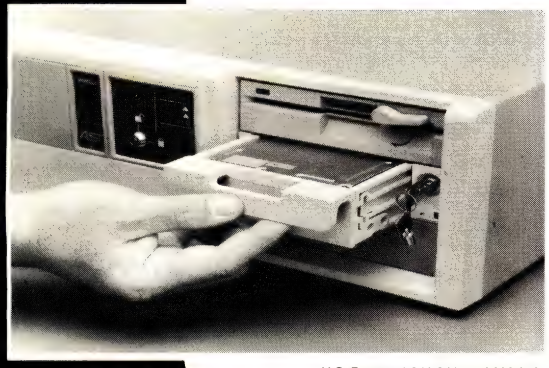
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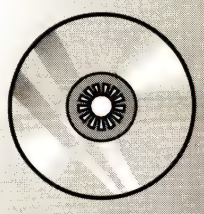
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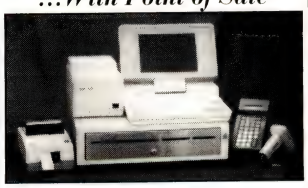
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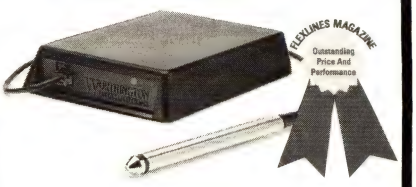
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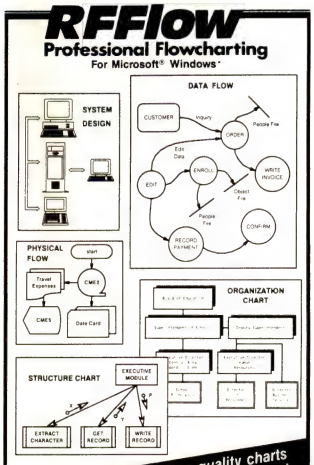
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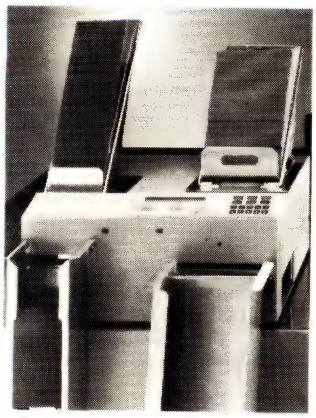
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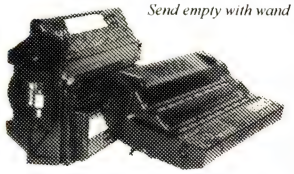
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PC MAGAZINE

Coming Up

The Best of 1993

We offer an unashamedly personal roster of *PC Magazine* editors' favorite picks—the hardware and software that knocked our socks off in 1993. These are the products we made room for in cluttered offices or on crowded hard disks, products that made us say "wow."

Service and Reliability: The Whole Picture

As competition in all areas of the computer industry continues to heat up, vendor warranties and service and support policies are becoming more of a distinguishing factor. In our latest Service & Reliability Survey, we ask *PC Magazine* readers what they think about their desktop and notebook PCs, printers, and monitors.

Spreadsheet Software: Less is More

There are fewer players in today's spreadsheet market than at any time in recent memory, but as the numbers dwindle, the power grows. The giants of this spreadsheet generation bristle with connectivity, analysis, and ease-of-use features that were unimaginable even a year ago. *PC Magazine* reviews DOS, OS/2, and Windows spreadsheet upgrades from Borland and Lotus—and previews Microsoft Excel, Version 5.0.

Mainstream Mice

The graphical user interface has done more for the popularity of the mouse than Walt Disney. Today's mice boast sophisticated drivers that you can customize to your work habits and improved ergonomic designs to protect users from carpal tunnel syndrome and other repetitive stress injuries. We tested 14 of the most popular mice on the market to see if there is such a thing as the perfect mouse.

Free Utility

If you've been using our PCUNZIP to decompress the files you download from ZiffNet, it's time to upgrade to the new PCDEZIP. Version 2 of the popular compression utility PKZIP has recently been released. PCDEZIP doesn't attempt to fully duplicate the functionality of the new PKUNZIP, but several valuable features have been added. You can use PCDEZIP to extract files zipped with either version of PKZIP.□

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DELRINA CONSUMER SOFTWARE DIVISION

The Far Side Daily Planner: Start Your Year With A Smile

BY JULIE COHEN

If you're like many people, turning on your computer in the morning is hardly a laughing matter. Delrina makes its annual challenge to these sourpusses with the Daily Planner and Calendar Publisher 3.0 for Windows.

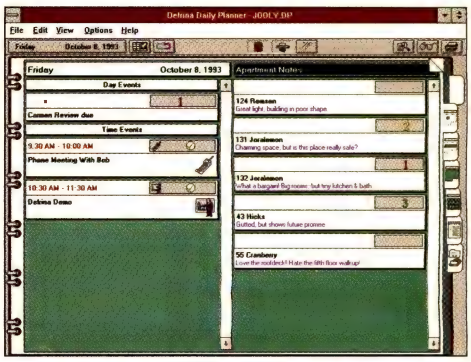
Sure, you could choose a humorless PIM, or rely on a faulty memory to keep track of your appointments. But if you'd rather start your morning by reading the funny pages, Delrina's planner is probably more your style. And it's in color every day—not just on Sundays.

Four modules are available. The Far Side Daily Planner, Volume III, features images from the totally off-the-wall mind of Gary Larson. Cathy Guisewite's Cathy module features that perpetually dieting, eternally dating career gal. And if you prefer a challenge greater than waking up in the morning, try the Trivial Pursuit and Word-a-Day calendars. Each sells for $19.95.

Well organized, with yearly, monthly, weekly, and daily views, each view provides notes in increasing detail. Day and week views, for example, may include animated icons and a full listing of each activity on the schedule. Monthly views show only the time and the activity for each day. Click on any part of the calendar to start making your notes.

Since Delrina took over the calendar's publication, the company has added several new, practical features to make this product more competitive with other PIMs that are on the market. There's a contacts list, greater search capabilities, and import and export abilities, as well as dynamic links to programs like Delrina WinFax PRO.

Best of all, however, is the program's ease of use. It does exactly what you expect it to do; just click on a day or date, and type in your plan. Drag-and-drop capabilities make rescheduling events a snap, too. Using Delrina's Daily Planner for Windows will set you up for a happy and organized new year.



FUNNY PAGES: A serious calendar lies behind the daily cartoons of Delrina's Daily Planner.

Daily Planner and Calendar Publisher 3.0 for Windows, *$49.95; additional modules, $19.95 each.* Requires: *4MB RAM, Microsoft Windows 3.0 or later, 3.5MB hard disk space. Delrina Consumer Software Division, 11810 115th Ave. N.E., Kirkland, WA 98034; 206-820-7007; fax, 206-823-0568.*

Circle 477 on reader service card

ACCOLADE INC.

Go, Speed Racer, Go!

BY DON WILLMOTT

It's been 28 years since Speed Racer first drove his powerful Mach 5, but MTV reruns and the promise of a new syndicated series suggest that this cult classic of truly awful Japanese animation is coming around the track one more time.

Accolade is right there with "Speed Racer in the Challenge of Racer X," a $59.95 DOS-based game that captures all the thrills and chills as Speed takes on all challengers, including the mysterious Racer X. And as you'd expect, impish little brother Spridle and Chim-Chim the bug-eyed monkey are hiding in the trunk.



DEMON ON WHEELS: Accolade jumps on the Speed Racer bandwagon.

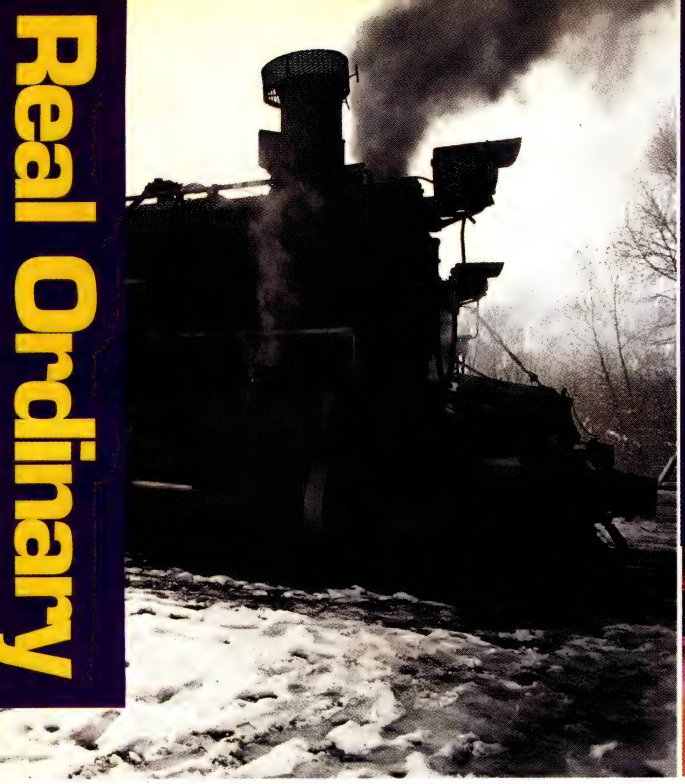
There are six race courses to try, and the graphics are excellent. If you don't want to drive the Mach 5, you can drive Racer X's car (but with all the gadgetry in the Mach 5—revolving blades for mowing down obstacles, autojacks for jumping over competitors—who'd want to?).

Two players can race together in a split screen mode, and you can even connect via 2,400-bps modem to race online with a friend.

And oh, that theme song...

Speed Racer in the Challenge of Racer X, *$59.95.* Requires: *3MB RAM, 9MB hard disk space, DOS 3.1 or later; sound card recommended. Accolade Inc., 5300 Stevens Creek Blvd., San Jose, CA 95129; 408-985-1700; fax, 408-246-1053.*

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There's more to games than a mouth that sort of moves or tinny sound. Now there's a new way to play PC games that's just like sitting in a theater controlling the action with your joystick.

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Baird Davis, Senior Vice President

DINNER AT EIGHT:

Three Cookbooks to Plan Your Meals

What's for dinner? That question echoes across the land millions of times every evening as we try to decide on something nourishing to put on the table. To answer that question, we pored over nearly a dozen cooking software programs and came up with three Microsoft Windows–based packages that you should consider for your shelf.

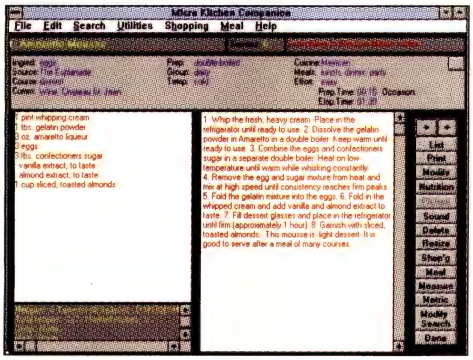
Micro Kitchen Companion, from the Lifestyle Software Group, uses the world-famous Betty Crocker cookbooks as its database. Pinpoint Publishing offers Micro Cookbook for Windows, which is stuffed with more than 1,000 public-domain recipes gleaned from boards and councils like the American Dairy Association. Recipes for Windows from Odyssey Computing in Carlsbad, CA, gets most of its 300 recipes for its software from its own employees.

The Micro Kitchen Companion is the champion for feature-packed software, but you'll have to buy several cookbooks at $25 to $35 in order to have a good variety of recipes. Micro Cookbook has more than 1,000 dishes, but the cumbersome way it adds and edits recipes makes it my last choice. The rather plain Recipes for Windows is a good choice for those who don't need nutritional information and advanced features like recipe resizing.

LIFESTYLE SOFTWARE GROUP

Micro Kitchen Companion

Lifestyle Software Group's collection of electronic cookbooks includes Betty Crocker's hard-cover editions, like "Eat and Lose Weight," "Italian Cooking," "Shortcut Cooking for the Smart Cook," "Low-Fat, Low-Cholesterol," "Old-Fashioned Cookbook," and the most famous, known simply as "Betty Crocker's Cookbook." This last book, often called Big Red because of its cover, has more than



BETTY'S BEST: Micro Kitchen Companion puts 227 Betty Crocker recipes on disk.

1,000 recipes and is considered one of the standards of cooking. Micro Kitchen Companion contains only 227 recipes, but lets you resize recipes, search for recipes using certain ingredients, and manage your shopping list at the touch of a button.

Opening this cookbook can be a bit frustrating. It's fraught with Windows terminology, and file names such as TASTEW.Y may confuse any user. Once you get the cookbook opened, you face an unfriendly blank screen with a list of key words at the top.

Once you choose a recipe, however, Micro Kitchen Companion is more friendly and logical, with three separate screens for the recipe's classification, a list of ingredients, and preparation steps. A toolbar on the recipe screen has buttons for resizing the recipe, displaying nutritional values, copying the ingredients to a shopping list, and printing the ingredients and directions. The latter feature is particularly well-designed and even has a format for printing 3- by 5- and 4- by 6-inch index cards.

Micro Kitchen Companion's meal-planning feature has several capabilities. You can pick a group of recipes and give them a name (say, "Zax's Birthday Meal"), display their nutritional value, and create a shopping list for that group. (One caution about this and other programs' shopping lists: None of the cookbook software combines like ingredients. For instance, if one recipe calls for three eggs and another for four eggs, there will be separate egg entries on the shopping list instead of a single entry for seven eggs.)

Micro Kitchen Companion's best feature is its editing ability, which allows you to change recipes and add your own. Even if you don't use the Betty Crocker dishes, this program provides a good framework for managing your recipes and shopping list.

Micro Kitchen Companion, *$49.95; companion cookbooks in the series, $25 to $35 each.* Requires: *4MB RAM, Windows 3.0 or later, MSCDEX 1.0 or later, 5MB hard disk space. Lifestyle Software Group Inc., 63 Orange Street, St. Augustine, FL, 32084; 800-289-1157; fax, 904-825-0223.*

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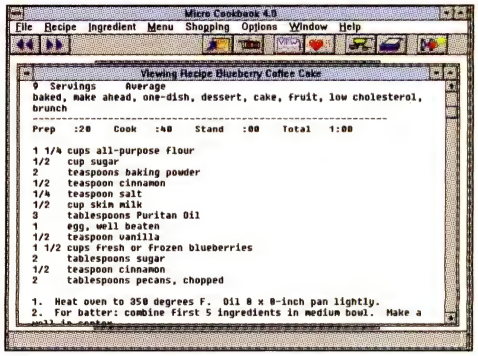
PINPOINT PUBLISHING

Micro Cookbook for Windows

No, this isn't a cookbook dedicated to microwave cooking, but rather a collection of 12 cookbooks with recipes that come from sources as diverse as Nabisco Foods Group, the Florida Citrus Board, and the American Beekeeping Federation.

After selecting one of the 12 descriptive cookbook names from a list that includes "Company's Coming," "Low Fat," and "Beef, Lamb, and Pork," a window opens with an alphabetical listing of the recipes. Use the slide bar to review the titles or to enter a name in the search field. "Cake," for example, brings up ten mouthwatering choices from the book entitled *America's Famous-Name Foods.*

Using the global recipe finder, you can search all cookbooks for dishes based on name, ingredients, health interest, cuisine, cooking methods, or any of several other factors. Searching for eggs as an ingredient, for example, yields 76 recipes from apple



A THOUSAND CHOICES: Micro Cookbook for Windows contains the most recipes.

bean cake to turkey burgers. Using buttons at the top of the screen you can view individual recipes, check the nutrition, and add the ingredients to a shopping list. You can also combine recipes into named meals for easy reference and future retrieval.

The printed shopping list is organized by grocery store shelf categories so all dairy products are grouped together and all vegetables are grouped together. As previously noted, however, separate quantities of like ingredients are not combined. The store-shelf organization is a great timesaver when shopping for several meals at once.

The recipe screen displays the ingredients at the top with the instructions below, very much like conventional cookbooks. This screen is easy to read, but the program's resizing feature (which can convert a recipe for four to one for 40) makes the recipes difficult to edit. You must open the recipe in an edit window, and enter your data in a confusing array of boxes, using predefined measures like tsp., loaf, and quart, since the resize feature uses those terms for its conversions. This same degree of precision is required when entering your own recipes. I found it so cumbersome that I gave up. This is unfortunate because the print feature is ideal for printing your own cookbooks in several formats, including letter size, legal size, and two different index-card sizes.

Micro Cookbook combines many good recipes in an easy-to-use package, but is a poor choice for editing existing recipes and entering your own. The shopping list feature is notably good.

Micro Cookbook for Windows, *$59.95.* Requires: *4MB RAM, Windows 3.1 or later, 6MB hard disk space. Pinpoint Publishing Inc., P.O. Box 7329, Santa Rosa, CA, 95407-0329; 800-788-5236; fax, 707-523-0469.*

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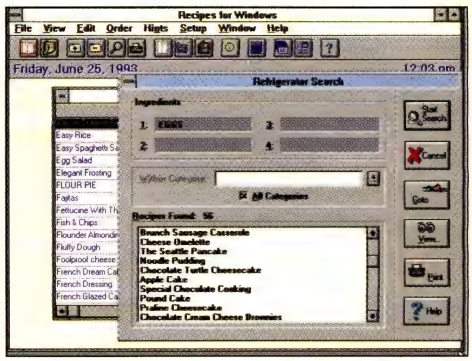
ODYSSEY COMPUTING

Recipes for Windows

Recipes for Windows is the least powerful and least expensive cookbook we reviewed; it has only about 300 recipes, most of which come from company employees and friends. Perhaps because it is not as fully developed as the other products, it is simpler to use.

The opening window is an alphabetical list of recipes. Click on one and a window opens showing the recipe's ingredients; click another button to review the directions. I would prefer that both ingredients and directions be in the same window, but Recipes for Windows provides a workable solution.

Changes in both preparation directions and ingredients can be made directly in the display window without having to bring up a separate edit screen. It's very easy, for example, to add a notation to use less water next time and substitute brown for white sugar. Cooks who constantly improvise and change recipes will appreciate this feature.



WHAT'S FOR DINNER? Recipes for Windows helps you narrow your search.

The cookbook can be searched by ingredient, name, category, prep time, and recipe source. The ingredient search, called a refrigerator search, is poorly designed and confusing. There are four boxes in which to enter ingredients; entering Milk, Eggs, and Wine, for example, does not fetch all recipes with those three ingredients, but rather brings up any recipe that has any of those elements. I can't imagine an occasion in which a cook would need that type of search.

Recipes for Windows' coupon organizer is a handy feature not found in the other cookbooks we reviewed. Use it to enter the expiration date, group, and description for each coupon you clip. A smiley face turns sad when the coupon expires, but it would be more helpful if it changed color a week before the expiration. The coupon organizer would be an outstanding feature if it were tied to the shopping list to show which items were covered by coupons, but it isn't.

Recipes for Windows lacks several features found in the other programs, namely meal planning, nutritional information, and recipe resizing. The developer says these features will be in the next version of the product, although frankly, I did not miss them.

Recipes for Windows, *$39.95.* Requires: *Windows 3.1 or higher, 2MB RAM recommended, DOS 3.3 or higher, 1.6MB hard-disk space. Odyssey Computing Inc., 5962 La Place Court, # 215, Carlsbad, CA, 92008; 619-929-7828; fax, 619-929-1012.*

Circle 481 on reader service card

Forty CDs in One-Fourth the Space

by Don Willmott

Here's an interesting gizmo. SC&T International's $34.95 CD3 holds 40 audio CDs or CD-ROM disks in a slotted, jukebox-like configuration. You list the titles on the front, slide the grabber to the appropriate number, and lift the lid, and the disk pops up. Close the lid and lift the carrying handle, and the disks are safely locked in, making the whole thing portable.

The instructions don't suggest what to do with your CD jewel boxes and the little booklets that come with them, but if you need to maximize your storage space or want to take dozens of CDs on the road with you, this is a convenient way to do it.

CD3, *$34.95. SC&T International Inc., 3837 E. La Salle St., Phoenix AZ 85040; 602-470-1334; fax, 602-470-1507.*

Circle 484 on reader service card

SOFTWARE MARKETING CORP

SportsWorks: A Medal-Quality Guide To Sports Through the Ages

BY MELISSA J. PERENSON

Ever wonder about the specifications of gymnastics equipment? Or what types of dives are recognized in competition? If these and other sports-related questions are burning in your mind, try consulting the encyclopedic reference program SportsWorks, an easy-to-navigate, DOS-based program that will educate the passive sports spectator and delight die-hard fans.

Twelve categories encompass more than 150 common and lesser-known sports, ranging from swimming, gymnastics, and track and field to aikido, boules, and croquet. There's a section on Olympics history, complete with highlights from ancient times through 1992, and essays on sports medicine, politics and sports, and sexism in sports.

SportsWorks can print and export text and graphics as ASCII or .PCX files. A tour function will automatically prompt you through all available information on the sports family of your choice. Subject quizzes test your retention of newly acquired knowledge. Bookmarks, which not retained after exiting the program, and an index offer simple searching options.

Although it gets a good start off the blocks, SportsWorks has room for improvement. You'll probably want more than the program delivers, in terms of both graphical animation and textual content. Some things are sidestepped altogether; under the 1988 Olympics, for example, the program states, "East Germany's Katerina Witt gave a stunning performance to take the gold in figure skating," without mentioning the historical significance of Witt's second consecutive gold medal effort. Still, for its breadth, if not its depth, SportsWorks earns a silver medal.□



TAKE THE PLUNGE: SportsWorks' wide variety of categories makes a splash.

SportsWorks, *$49.95.* Requires: *530K RAM, 9MB hard disk space, DOS 3.3 or later. Software Marketing Corp., 9830 South 51st St., Bldg. A-131, Phoenix, AZ 85044; 602-893-3377; fax, 602-893-2042.*

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MOVING?

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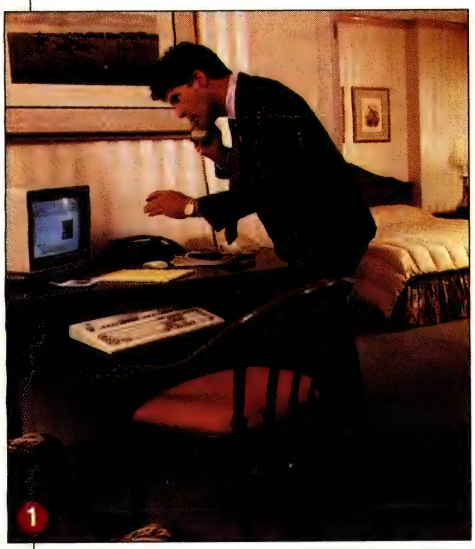
Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

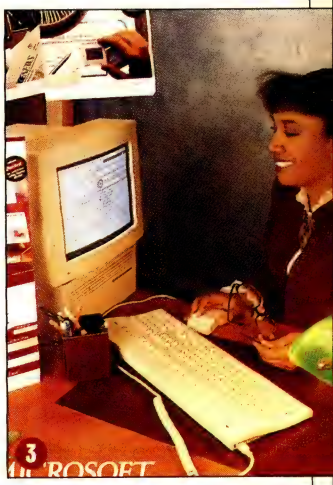
By Don Willmott

What's Wrong with These Pictures?

Try to find the silly mistake in each of the following seven ads. In case you're stumped, helpful clues await you below.













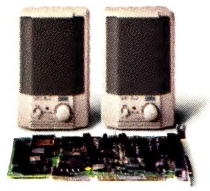


HINTS

1. "Hello, bellboy? You forgot one piece."
2. Where's the rest of me?
3. Get a grip!
4. A tower of power?
5. I seem to have a bad connection.
6. You put your paper in, you take your paper out.
7. Talk about high density!

If your entry is used, we'll send you $50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802. Winners this issue: John Arnold, Doug Hay, Ray Martin, John Patrick Ng, Stephen J. Rockower, Brett L. Tholborn, and Harvey Watson.

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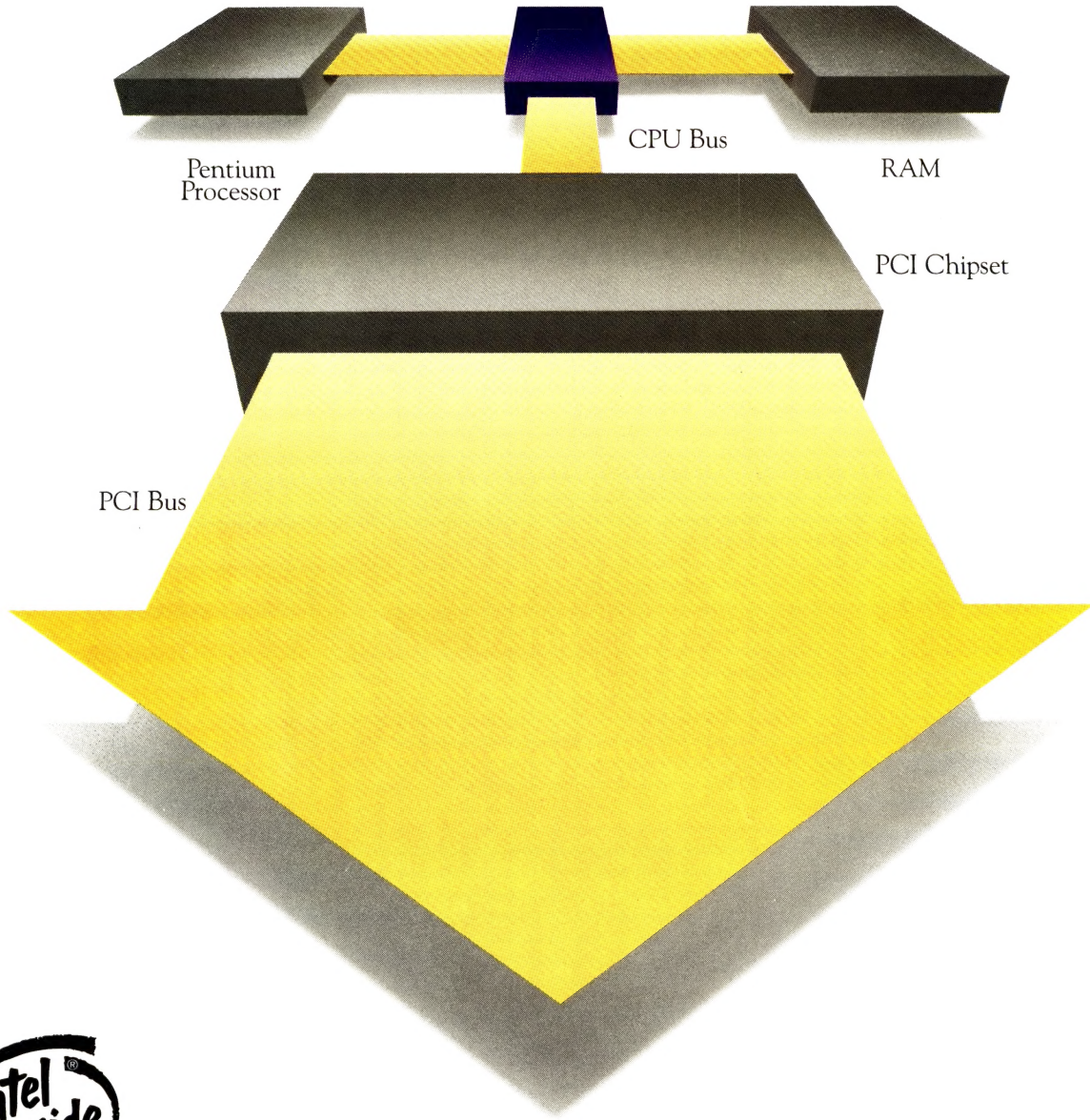
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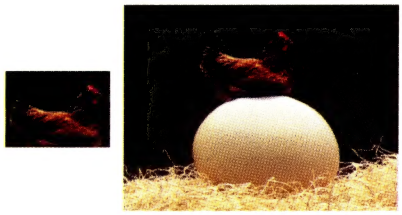


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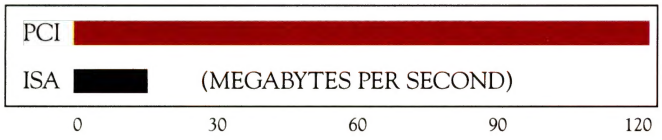
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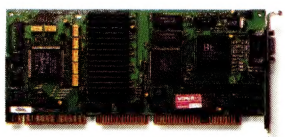
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